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ABSTRACT

This bibliography lists the holdings of the Northwest Regional Educational Laboratory's Test Center in the area of assessment alternatives in mathematics. Annotations describe the instruments or articles and indicate availability. Each entry is coded according to type, purpose, grade levels, content covered, type of tasks, skills assessed, and type of scoring. An index by each category of coding is provided. Some of the entries are large-scale assessment instruments, some are informal assessments intended mainly for the classroom, and some are protocols intended primarily for research. (MKR)

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ED 392 594

Innovative Assessment

BIBLIOGRAPHY OF ASSESSMENT ALTERNATIVES:

MATHEMATICS

Fall 1995 Edition

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Innovative Assessment

Bibliography of Assessment Alternatives: MATHEMATICS

Fall 1995 Edition

The Test Center
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BIBLIOGRAPHY OF ASSESSMENT ALTERNATIVES MATHEMATICS

September 1995

The following articles represent Test Center holdings to date in the area of assessment alternatives in mathematics. Presence on the list does not necessarily imply endorsement; articles are included to stimulate thinking and provide ideas. Some of the entries are informal assessments, and are intended mainly for the classroom. For more information, contact Matthew Whitaker, Test Center Clerk, at (503) 275-9582, Northwest Regional Educational Laboratory, 101 SW Main, Suite 500, Portland, Oregon 97204, e-mail: testcenter@nwrel.org. To purchase a copy of this bibliography, please call NWREL's Document Reproduction Service at (503) 275-9519.

Alberta Education. ***Diploma Examinations Program—Mathematics 30*****, 1991. Available from: Learning Resources Distributing Centre, 12360 - 142 St., Edmonton, AB T5L 4X9, Canada, (403) 427-2767, fax (403) 422-9750.**

Alberta Education develops diploma examinations in several course areas. These, combined with school-awarded "marks" are used to assign credit for the courses. The *Mathematics 30* examination has three parts: multiple-choice, "numerical response" (students "bubble" their answers onto the scan sheet), and written response. The test appears to only assess knowledge of the subject area rather than problem solving, communication, reasoning, etc. Examinations are given locally under controlled conditions. Papers are scored centrally. Scoring appears to be based on the correctness of the answer.

The mathematics test covers advanced algebra, geometry, trigonometry, and number theory.

(TC# 500.3DIPEXP)

ERIC

Alberta Education. *Diagnostic Mathematics Program*, 1990. Available from: The Learning Resources Distributing Centre, 12360 - 142 St., Edmonton, AB T5L 4X9, Canada, (403) 427-2767.

The *Diagnostic Mathematics Program* provides assessment and instructional materials for five goal areas (numeration, operations/properties, measurement, geometry, and problem solving) at six grade levels (1-6). Each handbook contains "observation checklists," "structured interviews," and written tests for subskills within each skill area. "Observations" require teachers to make a judgment of the skill level (strong, adequate, or weak) of the student in each area to identify those students for whom further evaluation is necessary. Some assistance is given on the criteria for making these judgments.

"Interviews" require students to do written or oral math work. Except for a few problems in the problem-solving handbook, problems are atomistic—each problem is designed to assess a different skill. Except for a few problems in the problem-solving handbook, tasks are atomistic (each task is designed to assess a different small skill). Responses are short answer and are scored right/wrong. Total correct is used to assign a rating of "strong," "adequate," or "weak" for each skill. No rationale is provided for the cut scores given for each rating. In the problem-solving handbook, a few problem solutions are scored judgmentally on a holistic scale of 0-2 in three areas: "understanding the problem," "developing and carrying out the plan," and "looking back." No technical information is provided. These documents are best used informally by classroom teachers to track progress on individual math skills.

(TC# 500.3DIAMAP)

Algina, James, and Sue Legg (Eds.). *Special Issue: The National Assessment of Educational Progress*. Located in: <u>Journal of Educational Measurement</u> 29, Summer 1992.

This special issue of <u>JEM</u> discusses the National Assessment of Educational Progress (NAEP)—history, specification of content and design of assessments for 1992 and beyond, how students are sampled, and how results are reported. Although some articles are somewhat technical, the general pieces on NAEP's history, and the design of current assessments will be interesting to the general readership.

Current plans for math include:

1. Use of calculators for about 70 percent of the test.

2. Estimation skills tasks using an audiotape.

3. Yes/no questions to determine the extent to which students understand the same information when it is presented in different forms.

4. Constructed response questions in which students are asked to document their solutions by drawing their answers, writing explanations, or providing their computations.

Scoring guides for open-ended questions are task-specific. Some examples are provided.

(TC# 150.6JEM292)

Alper, Lynne, Dan Fendel, Sherry Fraser, et al. ***Various documents on the Interactive Mathematics Program (IMP)*****, 1993-94. Available from: EQUALS, Lawrence Hall of Science, University of California, Berkeley, CA 94720, (510) 642-1910, fax (510) 643-5757. Information also available from: Linda Witnov, IMP Outreach Coordinator, 6400 Hollis St., Suite 5, Emeryville, CA 94608, (510) 658-6400.**

This document includes several papers about the Interactive Mathematics Program which:

- Discuss the philosophy guiding the program
- Provide examples of instructional activities, including "Problems of the Week" and student self-reflection
- Report evaluations of the impact of the project on students; impact was measured by the SAT and two attitude measures (which are included); (no performance assessment was used as an outcome measure; the performance assessments described in the materials include tasks but no performance criteria)

Some sample student work is included.

(TC# 500.3VARIMP)

Appalachia Educational Laboratory. ***Alternative Assessments in Math and Science: Moving Toward a Moving Target*****, 1992. Available from: Appalachia Educational Laboratory, PO Box 1348, Charleston, WV 25325, (304) 347-0400.**

This document reports a two-year study by the Virginia Education Association and the Appalachia Educational Laboratory which twenty-two K-12 science and math teachers designed and implemented new methods of evaluating student competence and application of knowledge. Teachers who participated in the study felt that the changes in assessment methods led to changes in their teaching methods, improvements in student learning and better student attitudes. Instruction became more integrated across subjects, instruction shifted from being teacher-driven to being student-driven, and teachers acted more as facilitators of learning rather than dispensers of information.

Included in the report is a list of recommendations for implementing alternative assessments, a list of criteria for effective assessment, and 22 sample activities (with objectives, tasks, and scoring guidelines) for elementary, middle, and high school students, all designed and tested by the teachers in the study.

Most activities have performance criteria that are holistic and task-specific. No technical information or sample student work is included.

(TC# 600.3ALTASM)

Arizona Student Assessment Program. ***Mathematics: Expressions and Equations; Mathematics: Identifying Shapes; Mathematics: Statistics; Writing: Specialized Expository Paper; Writing: Persuasive Paper;*** **and** ***Reading: Poem;*** **1992-93. Available from: The Riverside Publishing Company, 8420 Bryn Mawr Ave., Chicago, IL 60631, (800) 323-9540.**

Arizona is developing open-response, on-demand assessments in math, reading, writing, social studies, and science for grades 3, 8, and 12. The math test has been used for about two years; the science test is still under development. The mathematics test requires a minimum of manipulatives. Students provide short answers to a series of questions surrounding a common theme, such as a rock climbing competition or a "pizza spinner." They also sometimes provide explanations for responses or show computations.

Scoring is based on a four-point general holistic rubric. The correct answers are given for individual parts of the activity and the reader assigns 0-4 points depending on understanding the problem, logical reasoning, effective communication, and correctness and completeness of the response.

The tests were developed by Riverside and are under copyright restriction until at least 1996. Permission to use any part of the assessment must be granted by both Riverside and the Arizona Department of Education.

(TC# 500.3ARISTM2)

Aurora Public Schools. ***Performance Assessments in Science and Mathematics,*** **1992. Available from: Strategic Plan Facilitator, Aurora Public Schools, Department of Instructional Services, 15751 E. 1st Ave., Suite 220, Aurora, CO 80011, (303) 340-0861, fax: (303) 340-0865.**

The author has provided three high school examples of the types of assessments being developed by teachers in Aurora Public Schools: developing an analogy for the major anatomical and physiological components of a typical eukaryotic cell, recommending a decision concerning the future use of a medical technology in human biology, and collecting and analyzing a data set. These examples include a description of the task, prerequisite student experiences, and criteria for judging student performance on the task. Students work in groups of two to four. The assessments are mostly for classroom use.

Performances are evaluated along several dimensions including content, complex thinking, decision making, and collaborative working. Most of the rubrics are task specific and emphasize relative quality. For example, a "4" score for complex thinking on the medical technology task is: "The student clearly and completely identified the criteria by which the alternatives were assessed. The criteria were presented in detail and reflected an unusually thorough understanding and concern for the repercussions of the decision." The collaborative worker rubric is generic and more descriptive; a "4" is "The student expressed ideas clearly and effectively; listened actively to the ideas of others, made a consistent effort to ensure that ideas were clearly and commonly understood; accurately analyzed verbal and non-verbal communications, solicited and showed respect for the opinions of others."

No technical information nor sample student responses are included.

(TC# 000.3SCIMAP)

Badger, Elizabeth. ***On Their Own: Student Response to Open-Ended Tests in Mathematics,*** **1989-1991. Available from: Massachusetts Educational Assessment Program, Massachusetts Department of Education, 350 Main St., Malden, MA 02148, (617) 388-3300.**

This document contains assessment materials for grades 4, 8, and 12 from three years (1988-1990) in four subject areas (reading, social studies, science and math). In 1988 and 1990 students solved problems and explained their answers. These problems emphasized the major areas of patterns/relationships, geometry/measurement, and numerical/statistical concepts. All problems were written. Responses were scored both for correctness of solution and for quality of the explanation. No specific criteria for judging quality of explanation were given. Several examples of student responses illustrating various conclusions are included.

In 1989, 2,000 students were assigned one of seven performance tasks (four in math required manipulatives) to do in pairs. Each pair was individually watched by an evaluator. It took 65 evaluators five days to observe the 2,000 performances. Evaluators checked off those things that students did correctly (e.g., measure temperature), and recorded students' conversations and strategies. Specific criteria are not included.

Some information on results for all the assessments is provided: percentages of students getting correct answers, using various strategies, using efficient methods, giving good explanations, etc., depending on the task. Many examples of student responses illustrating these various points are provided. No technical information about the assessments themselves is provided.

(TC# 500.3ONTHOM)

Bagley, Theresa, and Catarina Gallenberger. ***Assessing Students' Dispositions: Using Journals to Improve Students' Performance.*** **Located in: <u>The Mathematics Teacher</u> 85, November 1992, pp. 660-663.**

The authors discuss the use of journals to elicit student behavior that can be examined for high school student attitude toward math, ability to make mathematical connections, and understanding. They present many questions, tasks, and instructions for getting students to self-reflect, and provide good, practical suggestions for managing the process. However, the authors do not provide criteria for examining student responses—what to look for in responses that are indicators of attitude, connections or understanding. Therefore, the papers will beuseful only to the extent that users have the expertise to know what to look for in responses

(TC# 500.6ASSSTD)

Baxter, Gail P., Richard J. Shavelson, Sally J. Herman, Katharine A. Brown, and James R. Valadez. ***Mathematics Performance Assessment: Technical Quality and Diverse Student Impact.*** **Located in: Journal for Research in Mathematics Education 24, 1993, pp. 190-216.**

The authors developed 41 hands-on tasks to measure three categories of sixth-grade student competencies: measurement (seven tasks), place value (31 tasks), and probability (three tasks). An example of a measurement task is "describe the object," in which students write a description of an object that someone else could use to draw the object. An example of a probability task was "spin it" in which students were given a spinner with eight sections (four orange, three yellow, and one green). They had to predict which color the pointer would land on most or least often, predict the outcome of 32 spins, carry out the experiment, and graph the results

Responses were scored either by degree of "correctness" or, in the case of the communication items (e.g., describe an object), holistically for general quality of the response. The tasks and criteria are described only in general terms; further information would have to be obtained from the authors in order to actually reproduce the assessment.

Tasks were pilot tested with 40 sixth graders (Anglo and Hispanic) two types of instructional settings. hands-on and traditional. Results showed: raters using this type of rating scheme can be trained to be very consistent in their scoring; the assessments are costly and time-consuming; a considerable number of tasks need to be administered to provide a reliable estimate of a student's level of achievement; student performances on the hands-on tasks differed by the type of instructional setting (evidence of validity); and there was differential scoring on the part of Hispanics, leading to some equity concerns.

(TC# 500.6MATPEA)

Bellingham Public Schools. ***Primary Performance Portfolio, Grades K, 1, 2*** **and** ***Intermediate Performance Portfclio, Grades 3, 4, 5,*** **1992. Available from: Bellingham Public Schools, Box 878, Bellingham, WA. 98227, (360) 676-6400, fax (360) 676-2793.**

This document is an outline of suggestions for implementing portfolios for grades 1-5 Included are:

- A list of essential learnings in each grade level combined with suggestions of the type of information that could be included as evidence of progress on each goal. For example, a student goal in grades 3-5 is "literature competency." Portfolios could include response logs, performance or project scoring rubrics, or strategy checklists as evidence of attainment of this goal.

- Checklists and scoring guides for some of the skills. For example, fairly nice development continuums for reading, science, social studies, art, writing and mathematics are included, each having six levels (pre, emergent, beginner, developing, capable, and experienced). These are incorporated into a report card.

Also included are some materials for two units: history and energy. It is not clear how this material is used nor why it is included. No technical information nor samples of student work are included.

(TC# 000.3BELPUS)

British Columbia Ministry of Education. ***Performance Assessment: Primary, Early, Late, Intermediate, and Graduate, and Hypercard Tour.*** **Draft, August 1992. Available from: Ministry of Education, Assessment Branch, 617 Government St., Victoria, British Columbia V8V 2M4.**

This is a Macintosh disk containing a host of performance assessments developed by the British Columbia Ministry of Education for all grade levels and subject matter areas.

(TC# 000.3BCPERA)

Burns, Marilyn. ***Math and Literature (K-3)*****, 1992. Available from: Math Solutions Publications, Marilyn Burns Education Associates, 150 Gate 5 Rd., Suite 101, Sausalito, CA 94965, (415) 332-4181, fax (415) 331-1931.**

The author's premise is that "children's books are effective classroom vehicles for motivating students to think and reason mathematically." The book describes instructional ideas for linking math and literature in grades K-3. Samples of student work are included. The book is included on this bibliography because it might provide ideas for tasks that would be useful in performance assessments.

(TC# 500.5MATLIT)

Burton, Grace, Terrence Coburn, John Del Grande, et al. ***Addenda Series, Grades K-6: Curriculum and Evaluation Standards for School Mathematics*, 1991-92. Available from: National Council of Teachers of Mathematics, 1906 Association Dr., Reston, VA 22090, (800) 235-7566.**

Addenda is a series of booklets to support the NCTM Standards. This series provides instructional ideas for grades K-6 for the areas of patterns, geometry/spatial sense, making sense of data, and number sense/operations. The reference is included here because the exercises might suggest tasks that could be used in performance assessments.

(TC# 500.5ADDSEK)

California Assessment Collaborative. ***Charting the Course Toward Instructionally Sound Assessment—A Report of the Alternative Assessment Pilot Project*, September 1993. Available from: California Assessment Collaborative, 730 Harrison St., San Francisco, CA 94107, (415) 241-2704.**

The California Assessment Collaborative was designed as a three-year effort to systematically identify, validate, and disseminate alternatives to standardized testing throughout the state. This report presents findings from 22 projects during the first year, including costs, impacts, and recommendations about future work. The book does an excellent job of placing assessment change into the context of restructuring. It discusses how the following fit to ether: articulating content standards, monitoring student progress toward goals, building teacher capacity to assess, building student capacity to self-assess, student outcomes, curriculum, and instruction.

(TC# 150.6CHACOU)

California Assessment Program. ***A Sampler of Mathematics Assessment - Addendum - Preliminary Edition*, 1993. Available from: California Department of Education, PO Box 944272, Sacramento, CA 94244.**

The *Sampler Addendum* supplements a previous publication (see Pandey on this bibliography). While the previous publication provided an overview of the new assessment system, the addendum provides scoring guides and scored samples of student work in grades 4, 8 and 10.

(TC# 500.3SAMMAA2)

California Department of Education. *Students, Standards and Success—The California Learning Assessment System—Communications Assistance Packet*, 1993. Available from: California Department of Education, Publications Sales, PO Box 271, Sacramento, CA 95812, (916) 657-3747 or (800) 995-4099.

The purpose of this document is to introduce the *California Learning Assessment System* (CLAS) to the public. It gives an overview of the system and helps with setting up communication efforts. CLAS is administered in the spring at grades 4, 8, and 10 in reading, writing, and mathematics, and grades 5, 8, and 10 for science and social studies. There is also a portfolio component. CLAS is designed to give information on individual students, is tied to state standards, and is performance based. State law also specifies that CLAS links to curriculum frameworks and guides and should exemplify good instruction, including student engagement, thinking, problem solving, and communication. The document includes letters to parents, answers to frequently asked questions, sample press releases, sample meeting agendas, information on the assessments, resources, and sample items and student responses.

The math scoring guide is a four-point, holistic rubric emphasizing conceptual understanding and clear communication. The reading/writing scoring guide is a six-point, holistic scale that focuses on constructing meaning, developing connections, taking risks, and challenging the text. The writing scoring guide is a six-point, holistic scale that emphasizes position, organization, coherence, elaboration, relevance of arguments, awareness of style, and sentence variety.

(Note: California is currently reviewing its large-scale assessment; CLAS may not continue.)

(TC# 000.6STUSTS)

California State Department of Education. *A Question of Thinking: A First Look at Students' Performance on Open-Ended Questions in Mathematics*, 1989. Available from: California State Department of Education, PO Box 944272, Sacramento, CA 94244-2720, (916) 445-1260.

This report describes the results of a 12th grade student assessment using open-ended math problems. Scoring was task-specific and student work is included. This procedure was replaced by the later California entries on this bib. It is still included because others might find the problems useful.

(TC# 500.3AQUESO)

Carpenter, Thomas P., James Hiebert, Elizabeth Fennema, et al. *A Framework for the Analysis of Teaching and Learning Understanding of Multidigit Numbers*. Information on date and availability is unknown.

This paper presents a way to analyze instruction in math to see whether it is designed to foster understanding, defined as making relevant connections between knowledge. The specific

example in the paper relates to multidigit numbers. Dimensions of instruction thought to be critical in promoting understanding include: the scope and sequence of concepts, connections among representations as a basis for establishing meaning for symbols, the nature of problem solving, degree of teacher specification of solution procedures and connections, students' articulation of solution procedures, and coherence between and within lessons.

Most of the paper describes each of these dimensions in detail. Several pages at the end discuss in general terms the kinds of tasks one could give to students to see whether they are making the appropriate connections.

(TC# 500.4FRAANT)

Center for Talent Development. ***Elementary School Pre-Post Survey*** **and** ***Middle/High School Pre-Post Survey*****, 1992. Available from: Evaluation Coordinator, Center for Talent Development, Northwestern University, Andersen Hall, 2003 Sheridan Rd., Evanston, IL 60208, (708) 491-4979.**

This document contains surveys of student attitudes toward mathematics and science. There are two levels—elementary and middle/high school. It was designed for use with Access 2000 participants who are primarily African-American and Hispanic students in an inner-city public school system and enrolled in a math/science/engineering enrichment program. No technical information is included.

(TC# 220.3OUFFLM)

Champagne Audrey B. ***Cognitive Research on Thinking in Academic Science and Mathematics: Implications for Practice and Policy.*** **Located in: Enhancing Thinking Skills in the Sciences and Mathematics, Diane Halpern (Ed.), 1992. Available from: Lawrence Erlbaum Associates, Publisher, 365 Broadway, Hillsdale, NJ 07642, (800) 926-6579.**

Although this article is not strictly about assessment, it discusses some topics of relevance to assessment. Specifically, it has a very nice section on the relationship between the tasks given to students and what they learn. For example, students have more trouble integrating knowledge if they are never given tasks that require them to do this. Likewise, one can't assess a skill such as integrating knowledge if the assessment task doesn't require students to do it.

(TC# 000.6COGRET)

ERIC

Charles, Randall, Frank Lester, and Phares O'Daffer. ***How to Evaluate Progress in Problem Solving*****, 1987. Available from: National Council of Teachers of Mathematics, 1906 Association Dr., Reston, VA 22091.**

This monograph attempts to assist educators with the challenge of developing new techniques for evaluating the effectiveness of instruction in problem solving by clarifying the goals of problem-solving instruction, and illustrating how various evaluation techniques can be used in practice. Goals include: select and use problem-solving strategies, develop helpful attitudes and beliefs, use related knowledge, monitor and evaluate thinking while solving problems, solve problems in cooperative learning situations, and find correct answers.

Evaluation strategies include: informal observation/questioning and recording results using anecdotal records or a checklist (two are provided); interviews (a sample interview plan is provided); student written or oral self-report of what's happening during a problem-solving experience (a list of stimulus questions is given, as is a checklist of strategies); attitude inventories (two are given); rating scales (three-trait analytic and focused holistic scales are given); and multiple-choice and completion (sample items are given to assess various problem-solving abilities) No technical information nor student sample performances are provided.

(TC# 500.6HOWTOE)

Clark, David. ***The Mathematics Curriculum and Teaching Program*****, 1988. Available from: Curriculum Development Centre, PO Box 34, Woden, ACT 2606, Australia. Also available from: ERIC ED 287 722.**

This document was developed to assist classroom teachers in grades 1-6 to improve their day-to-day assessment of mathematics. Content includes: rationale for assessment alternatives in mathematics, instructions for a two-day inservice program using the materials, instructions on how classroom teachers can use the materials without training, and a series of exercises, formats and ideas for classroom assessment. Assessment ideas include: help with systematically recording information from informal observations using checklists and "folios" of student work, setting-up opportunities for assessment by giving students good tasks to do, assessing problem solving, student self-reflection, and communicating results.

This is written in a very user-friendly manner and contains some good ideas, especially in the areas of designing tasks, problem solving and self-reflection. We found some of the descriptions of activities a little too sketchy.

(TC# 500.3MCTPMA)

Clark, Glenda. ***AIM High Math Identification*****, 1992. Austin Independent School District Gifted and Talented Program, 711 E. 7th St., Austin, TX 78701, (512) 476-6861.**

This set of paper-and-pencil tasks was developed as one of five indicators for placing grade 2-5 students in the Austin Independent School District gifted math program. Each task has multiple open-response questions related to a common theme. Responses are scored on a scale of 1-5 using task-specific scoring guides. The document includes one task per grade level, the scoring guides, and student work samples. Not included are technical information or contextual information describing what the assessments are trying to measure.

(TC# 500.3AIMHIM)

Clarridge, Pamela Brown and Elizabeth M. Whitaker. *Implementing a New Elementary Progress Report.* Located in: Educational Leadership, October 1994, pp. 7-9. Also available from: Tucson Unified School District #1, 1010 E. Tenth St., Tucson, AZ 85719.

This paper reports on one district's attempt to revise its report card for grades K-5. Staff decided on a rubric approach. In grades 1-5, rubrics using four-point scales were developed for five "learner qualities"—self-directed learner, collaborative worker, problem solver, responsible citizen, and quality producer, and eight content areas—reading, writing, listening/speaking, mathematics, social studies, science, health, and fine arts. Room is provided on the report card for teacher comments, the basis for the judgment about student ability (e.g., classroom observation, portfolios), and teacher/student comments.

The authors describe development and pilot testing, preliminary responses from parents and students, plans for revision, and insights (such as "this approach to reporting requires a thorough understanding of the curriculum by both parents and teachers").

(TC# 150.6IMPNEE)

Collis, Kevin F. and Thomas A. Romberg. *Collis-Romberg Mathematical Problem Solving Profiles*, 1992. Available from: Australian Council for Educational Research Limited, (ACER), Private Bag 55, Camberwell Victoria 3124, Australia, (03) 277-5555, fax: (03) 277-5500. Also available from: ASHE, PO Box 31576, Richmond, VA 23294, (804) 741-8991.

This assessment device for students in grades 2-5 has 20 open-ended problems to solve—one problem in each of five areas (algebra, chance, measurement, number, and space) with four questions per problem area designed to tap developmental level of formal reasoning. For example, the "A" question determines whether the student can use one obvious piece of information from the item, while the "D" question determines whether the student can use an abstract general principle or hypothesis derived from the information in the problem. Responses to each question are scored right/wrong. The number of correct responses determines a developmental level. Suggestions are given for instructional strategies for the various developmental levels. Technical information in the manual includes typical performance for various grade levels, teacher judgment on the developmental level indicated by each task, and additional analyses to show validity of the inferences drawn.

(TC# 500.3COLROM)

Commission on Standards for School Mathematics. *Curriculum and Evaluation Standards for School Mathematics*, 1989. Available from: National Council of Teachers of Mathematics, 1906 Association Dr., Reston, VA 22091.

This book contains standards for curriculum and assessment that attempt to create a coherent vision of what it means to be mathematically literate. This book has been quoted extensively and is the current "standard" for what should be in a math curriculum.

The assessment section covers: three statements of philosophy concerning assessment (alignment, multiple sources of information, and appropriate assessment methods and uses); seven sections on assessing various student outcomes (e.g., problem solving, communication, reasoning, concepts, procedures, and dispositions); and four sections on program evaluation (indicators, resources, instruction, and evaluation team). Each of the seven sections on assessing student outcomes briefly describes what the assessment should cover and provides some sample assessment tasks and procedures.

(TC# 500.5CURANE)

Conley, David T. *Proficiency-Based Admission Standards*, January 8, 1995. Available from: PASS Project, Oregon State System of Higher Education, Office of Academic Affairs, PO Box 3175, Eugene, OR 97403, (503) 346-5799.

This paper describes the Oregon Board of Higher Education's new policy on admitting students by demonstration of competencies rather than number of courses taken or GPA. Included is the rationale for the approach (including the incongruity between traditional college admissions procedures and the attempt by K-12 schools to restructure), a list of the competencies, ideas for assessment, ideas for how high schools might need to change in order to ensure students meet admissions standards, and commonly asked questions. Competencies include subject area content (science, math, etc.) as well as basic and process skills (writing, reading, critical thinking, etc.).

The paper addresses the concern by some parents and teachers that changes in K-12 education won't mean anything if students are still admitted to college using traditional methods. The authors point out that similar changes in college admissions policy are occurring nationwide.

(TC# 150.6PROBAA)

Connecticut State Department of Education. *Connecticut Common Core of Learning Assessment*, 1989-1992. Available from: Connecticut State Department of Education, Division of Research, Evaluation, and Assessment, 165 Capitol Ave., Room 340, Hartford, CT 06106, (203) 566-4001.

This package contains a variety of documents produced between 1989 and 1992. Included are information about: rationale for the assessment, Connecticut's Common Core of Learning (student learning objectives), development process, several sample tasks and scoring mechanisms, student and teacher feedback forms, summaries of student and teacher feedback on the assessments using these forms, a process for developing performance tasks, a survey for student attitudes about science and mathematics, and an example of concept mapping as an assessment tool.

There appear to be two kinds of tasks: complex group projects and shorter on-demand tasks covering individual skills. The projects attempt to get at application and extension of knowledge and concepts. They require some individual and some group work and extend at least over several days. The on-demand portion covers knowledge and it's application in limited situations. Performances are scored for group collaboration, process skills, and communication skills. Some of the rubrics are task specific and some are general; some are based on quantity (the number of possible solutions listed, for example) and some are more quality based.

(TC# 000.3CONCOC)

Crowley, Mary L. ***Student Mathematics Portfolio: More Than a Display Case.*** **Located in: The Mathematics Teacher 86, October 1993, pp. 544-547.**

The author discusses the use of mathematics portfolios to document progress on the "big" NCTM outcomes—problem solving, valuing mathematics, developing mathematical confidence, communicating mathematically, and reasoning mathematically. She includes a fair amount of detail on a middle school example—sample letter to students outlining the task, a description of what students need to include and a hint of how content might be assessed. The portfolio is semi-structured—the teacher specifies categories of entries and the student selects which samples of work to include in each category. Students must also write explanations for their selections. A few samples of student work are included. Detailed performance criteria are not included.

(TC# 500.3STUMAP)

Csongor, Julianna E. ***Mirror, Mirror On The Wall...Teaching Self-Assessment to Students.*** **Located in: The Mathematics Teacher 85, November 1992, pp. 636-637. Also available from: Saint Maria Gosetti High School, 10th and Moore, Philadelphia, PA 19148.**

The author presents a procedure for getting high school students to self-reflect in math: during the final five minutes of a test, students estimate how sure they are about each answer they gave on the test (100%, 75%, 50%, or 0%). They can earn extra credit on the test if their estimates fall within 3% of their actual score. She reports that students are surprisingly accurate in their estimates and that the procedure works especially well with slow learners.

(TC# 500.3MIRMIW)

CTB McGraw-Hill. *CAT/5 Performance Assessment Component, 1993.* Available from: CTB/McGraw-Hill, 2500 Garden Rd., Monterey, CA 93942, (800) 538-9547, fax (800) 282-0266.

The "CTB Performance Assessments" are designed to either be stand-alone or integrated with the CAT/5 or CTBS/4 There are five levels for grades 2-11 The total battery includes reading/language arts, mathematics, science, and social studies and takes 2-3 hours to administer. There are 12-25 short- to medium-response questions for each subtest. The math and science subtests take 30-40 minutes. (For the CAT/5 there is a checklist of skills that can be used at grades K and 1)

Some questions are grouped around a common theme. Many resemble multiple-choice questions with the choices taken off. For example, questions on one level include: "What are two ways that recycling paper products helps the environment?" "This table shows the air temperatures recorded every two hours from noon to midnight...At what time did the temperature shown on the thermometer most likely occur?" and "These pictures show some of the instruments that are used in science...List two physical properties of the water in the jar below that can be measured with the instruments shown in the pictures. Next to each property, write the name of the instrument or instruments used to measure the property."

Some of the answers are scored right/wrong and some are scored holistically. The materials we received contained no examples of the holistic scoring so we are unable to describe it. Scoring can be done either locally or by the publisher. When the *Performance Assessments* are given with the CAT/5 or CTBS/4, results can be integrated to provide normative information and scores in six areas. There are only three, however that use the math and science subtests: demonstrating content and concept knowledge, demonstrating knowledge of processes/skills/procedures, and using applications/problem-solving strategies. When the *Performance Assessments* are given by themselves, only skill scores are available.

The materials we received contain sample administration and test booklets only. No technical information or scoring guides are included.

(TC# 060.3CAT-5a)

CTB McGraw-Hill. *CTB Math Task Bank,* undated. Available from: CTB/McGraw-Hill, PO Box 150, Monterey, CA 93942, (800) 538-9547, fax (800) 282-0266.

The "CTB Math Task Bank" contains 644 math tasks for grades 3-9. (There is also a language arts bank.) Each task has a series of questions around a theme. For example, the ninth grade bank contains a series of questions that relate to "selling advertisements for the yearbook." Questions require students to do such things as: identify how many ads of various sizes can fit on a single page; how much money different types of layouts can generate; and how many ads need to be sold to cover expenses Most tasks are, thus, very structured and have only one right answer. However, a few are more open-ended. For example, a grade 4 task is: "You and a friend are playing a guessing game. You think of the

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number 10. Your friend must guess the number you have chosen. Give your friend some hints to help him guess this number. On the lines below, write four different hints about this number using math ideas." Additionally, some tasks attempt to get at self-reflection: "Draw a circle around the number below that shows how easy or how hard it was for you to solve the problems in this task."

The materials we received do not elaborate on scoring. It appears that most questions are scored right/wrong. Presumably then, the total number of points on questions covering each skill provide an indication of student ability. No direct judgments of problem solving, reasoning, communication, etc are made.

Tasks can be accessed by student learning goal (tasks are cross-referenced to the NCTM standards), theme (e.g., year book ads), or question difficulty. CTB also publishes software to support the task bank. This includes test generation and scoring. The materials we received did not contain technical information.

(TC# 500.3CTBMAT)

Curriculum Corporation. ***Mathematics—A Curriculum Profile for Australian Schools, Mathematics—Work Samples,* and *Using the Mathematics Profile,* 1994. Available from: Curriculum Corporation, St. Nicholas Pl., 141 Rathdowne St., Carlton, Victoria, 3053, Australia, (03) 639-0699, fax (03) 639-1616.**

These documents represent the mathematics portion of a series of publications designed to reconfigure instruction and assessment in Australian schools. The project, begun in 1989, was a joint effort by the States, Territories, and the Commonwealth of Australia, initiated by the Australian Education Council.

The profiles are not performance assessments, per se, in which students are given predeveloped tasks. Rather, the emphasis has been on conceptualizing major student outcomes in each area and articulating student development toward these goals using a series of developmental continuums. These continuums are then used to track progress and are overlaid on whatever tasks and work individual teachers give to students.

The math profiles cover the major strands of: working mathematically, space, number, measurement, chance/data, and algebra. Each strand has sub-areas called "organizers." For example, the strand of "working mathematically" contains the organizers of: investigating, conjecturing, using problem-solving strategies, applying and verifying, using mathematical language, and working in context. Each organizer is tracked through eight levels of development. For example, the organizer of "using mathematical language" has "talks about mathematical ideas in natural language" at Level 1, and "makes fluent use of mathematical notation in solving problems and presenting arguments succinctly, coherently and in conventional forms" at Level 8.

There are lots of support materials that describe what each strand means, how to organize instruction, types of activities to use with students, and how to use the profiles to track progress. Samples of student work are included to illustrate development. The documents say that the levels have been "validated," but this information is not included in the materials we received.

(TC# 500.3MATCUP)

Doig, Brian. ***Activities and Assessment in Mathematics (AAIM)*, 1995. Available from: The Australian Council for Educational Research Ltd., 19 Prospect Hill Rd., Camberwell, Melbourne, Victoria 3124, Australia, 03-819-1400.**

The AAIM is a collection of over 200 math tasks which cover the five strands of the Australian *Curriculum Profile*—number, space, measurement, chance/data, and problem solving. It is designed for students in upper elementary and lower secondary (grades 4-9). The author suggests two primary uses—diagnosis of student skills in specific content areas, and tracking student development along the curriculum strands. All scoring is task specific. Since tasks are keyed to the stages of the curriculum profile, getting a high score on a task is, presumably, an indicator of student acquisition of skill at the level to which the task relates. The document includes a user's manual and all 200 tasks and associated scoring guides. No sample student work nor technical information is included.

(TC# 500.3ACTASM)

Educational Testing Service. ***Miscellaneous alternative assessments*, 1993. Available from: Educational Testing Service, 1979 Lakeside Pkwy, Suite 400, Tucker, GA 30084, (404) 723-7424.**

Six teams of elementary and middle schools in Georgia, in conjunction with the ETS Southern Field Office in Atlanta, are working on math and science assessment activities (cooperative group, videotape, open-ended experiments) that can be used across grades and content areas, and that are designed to assess science process skills, math problem solving, ability to communication in science and math, and content knowledge.

The materials we have include scoring guides (both general and task-specific, and holistic and analytical trait) and scored samples of student work. No technical nor contextual information is included in the materials (although such information is available from the publisher).

Any use requires permission from Educational Testing Service.

(TC# 000.3MISALA)

Educational Testing Service. ***NAEP 1992 Mathematics Report Card for the Nation and the States*****, April 1993, Report No. 23-ST02. Available from: Education Information Branch, Office of Educational Research and Improvement, US Department of Education, 555 New Jersey Ave NW, Washington, DC 20208, (800) 424-1616 or (202) 219-1651.**

The National Assessment of Educational Progress (NAEP) is congressionally mandated. Tests are given in reading, writing, math, science, social studies, fine arts, writing, literature, career development, and computers to students in grades 4, 8, and 12 on a revolving basis—not all subject areas are given each year. This entry describes the 1992 math assessment which tested approximately 220,000 students from 9,000 schools.

The on-demand tests covered numbers/operations, measurement, geometry, data analysis/statistics/probability, algebra/functions, and estimation. These content areas were covered at three levels: conceptual understanding, procedural knowledge, and problem solving. Some questions were multi-step. Calculators were allowed. There were both multiple-choice and short answer (e.g., measure an angle and write in the measurement) questions. Some of the questions required short explanations. For example, one fourth grade question asked students to choose the graph that represented the number of pockets in the clothing worn by a class of 20 students and provide an explanation of why they picked the graph they did. Responses were scored right/wrong.

The 1992 math assessment marks a shift to reporting by proficiency levels. For example, the "Basic" level designates conceptual and procedural understanding, while the "Advanced" level represents the ability to generalize and synthesize concepts and principles. (Note: The setting of cut-off scores on the tests relative to these levels has been controversial from a technical standpoint and will undergo further refinement.)

The report contains NAEP background information on the achievement levels and how they were set, sample items illustrating the levels, and lots of tables of results by states, regions, and various demographics such as gender and ethnicity. Released sets of items are available in other documents.

(TC# 500.6NAEPMAR)

EQUALS. ***Assessment Alternatives in Mathematics*****, 1989. Available from: University of California, Lawrence Hall of Science, Berkeley, CA 94720, (415) 642-1823.**

This document provides an overview of some possible assessment methods in mathematics that cover both process and products. Specific examples are given for writing in mathematics, mathematical investigations, open-ended questions, performance assessment, observations, interviews, and student self-assessment. Any of the student-generated material could be self-selected for a portfolio of work. The document also includes a discussion of assessment issues and a list of probing questions teachers can use during instruction.

(TC# 500.6ASSALI)

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Ferguson, Shelly. ***Zeroing in on Math Abilities*, 1992. Located in: <u>Learning92</u>, Vol. 21, pp. 38-41.**

This paper was written by a fourth grade teacher and describes her use of portfolios in math—what she has students put in their portfolios, the role of self-reflection, getting parents involved, and grading. She gives a lot of practical help. One interesting idea in the paper has to do with grading. At the end of the grading period she reviews the portfolios for attainment of concepts taught (not amount of work done), and progress toward six goals set by the NCTM standards (e.g., thinks mathematically, communicates mathematically, and uses tools). She marks which goals were illustrated by the various pieces of work in the portfolio and writes a narrative to the student. Another interesting idea is formal presentations of their portfolios by students to their parents. The article provides a sample comment form for parents and students to complete.

(TC# 500.3ZERMAA)

Finston, D., A. Knoebel, and D. Kurtz. ***Student Assessment Using Student Research Projects*, 1993. Available from: Douglas S. Kurtz, Professor of Mathematics, Department of Mathematical Sciences, New Mexico State University, Box 30001, Las Cruces, NM 88003, (505) 646-6218.**

This program (used in grades 9-university) is based on "student research projects," multi-step assignments lasting up to several weeks, which focus on problem-solving skills and writing. Students work in groups of 3-4. Sample projects in the document include remodeling a house, deciphering averages, determining tunnel clearances, and designing revolutionary solids. Assessment of student work is based on teacher evaluation of written reports. The sample scoring guides included in the document generally include content, process, and communication skills, but are fairly sketchy. No technical information is included.

The author is in the process of preparing a book compiling information on the student research projects, but grants permission to educators for reproduction.

(TC# 500.3STUASU)

Fitzpatrick, Robert and Edward J. Morrison. ***Performance and Product Evaluation*. Located in: <u>Educational Performance Assessment</u>, Fredrick L. Finch (Ed.), 1991. Available from: The Riverside Publishing Company, 8420 Bryn Mawr Ave., Chicago, IL 60631, (800) 323-9540.**

This paper has interesting discussions of the following topics:

1. What "authenticity" in tasks means. The authors' position is that there are many degrees and kinds of artificialities in tests. "Performance and product evaluation are those in which some criterion situation is simulated to a much greater degree than is represented by the usual paper-and-pencil test.... [However,] there is no absolute distinction

between performance tests and other classes of tests—the performance test is one that is *relatively* realistic."

2. Criteria for deciding how much "reality" to include in tasks

3. Descriptions of various types of tasks that can be used in performance assessments in-basket, games, role-plays, projects, etc

4. Steps for developing performance assessments analysis of the important dimensions of the skills to be covered, identification of tasks that cover as many of the important skills as possible, developing instructions and materials, and developing the scoring procedure

Most specific examples are taken from military and business applications

(TC# 150.6PERPRE)

Flexer, Roberta J. and Eileen A. Gerstner. ***Dilemmas and Issues for Teachers Developing Performance Assessments in Mathematics—A Case Study of the Effects of Alternative Assessment in Instruction, Student Learning and Accountability Practices*****, CSE Technical Report 364, October 1993. Available from: National Center for Research on Evaluation, Standards, and Student Testing (CRESST), Graduate School of Education, University of California, Los Angeles, CA 90024, (310) 206-1532.**

This monograph is the first in a series reporting on an ongoing study of the implications of alternative assessments (in reading and mathematics) in third grade classrooms and its impact on instruction, teachers' beliefs, and students' achievement. The purpose of this paper was twofold: (a) to discuss some of the dilemmas and issues that arose in the first two terms of work by the authors and participating teachers, and (b) to give a progress report on how teachers have changed their instruction and assessment as a result of the project. Results of the study were "mixed but promising."

(TC# 000.6DILIST)

Fort Hays Educational Development Center, The. ***State Assessment—Math*****, March 15, 1995. Available from: Steve Nolte, The Fort Hays Educational Development Center, 305 Picken Hall, Hays, KS 67601, (913) 628-4382, fax (913) 628-4084.**

Beginning with the 1995 administration, the Kansas math assessment covers problem solving, reasoning, and communication skills in grades 4, 7, and 10. Multiple choice, multiple mark, and open-ended items are used.

The open-ended problems include many content areas and skills and involve no manipulatives. Open-ended problems are scored for math communication, reasoning, and problem solving using a six-point (0-5), generalized rubric. Problem solving is broken down into four dimensions—understanding the problem, choosing a problem solving strategy, implementing

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the strategy, and finding/reporting a conclusion. This document includes rubrics, scoring forms, and 30 pages of student work in grades 4, 7, and 10. No technical information is included.

(TC# 500.3STAASM)

Fraser, Barry J., John A. Malone, and Jillian M. Neale. ***Assessing and Improving the Psychosocial Environment of Mathematics Classrooms.*** **Located in: Journal for Research in Mathematics Education 20, 1989, pp. 191-201.**

This article describes the development of a short form of the *My Class Inventory* to be used in sixth g ade math classes to measure the "psychosocial" characteristics of the classroom learning environment, e.g., social interactions.

(TC# 500.3ASSIMP)

Glaser, Robert. ***Expert Knowledge and Processes of Thinking.*** **Located in: Enhancing Thinking Skills in the Sciences and Mathematics, Diane Halpern (Ed.), 1992. Available from: Lawrence Erlbaum Associates, Publisher, 365 Broadway, Hillsdale, NJ 07642, (800) 926-6579.**

In this article the author describes current research on expert performance. Although not directly about assessment, the notion of "expertise" can be used to develop criteria for evaluating performance tasks. For example: experts perceive large, meaningful patterns, have skillful self-regulatory processes, etc.

A critical point made by the author is that, "Practice, as it comes about in the usual course of training, is not necessarily very efficient. On the basis of our knowledge of the specific aspects of competence and expertise, we are able to find ways to compress or shortcut experience...." "This is one goal for performance assessment, we help students understand current conceptions of the relevant dimensions of a task so that they don't have to rediscover this themselves."

(TC# 050.6EXPKNP)

Greenwood, Jonathan Jay. ***On the Nature of Teaching and Assessing "Mathematical Power" and "Mathematical Thinking."*** **Located in: Arithmetic Teacher, November 1993, pp. 144-152.**

This is a useful paper for assisting teachers in defining the characteristics of sound mathematical thinking.

The authors discuss (1) the meaning of the NCTM goals of "mathematical power" and "mathematical thinking," (2) seven characteristics of sound mathematical thinking, and (3) general rating scales for each characteristic.

The seven characteristics are: (1) Everything you do in mathematics should make sense to you. (2) Whenever you get stuck, you should be able to use what you know to get yourself unstuck. (3) You should be able to identify errors in answers, in the use of materials, and in thinking. (4) Whenever you do a computation, you should use a minimum of counting. (5) You should be able to perform calculations with a minimum of rote pencil-paper computations. (6) When the strategy you are using isn't working, you should be willing to try another strategy instead of giving up. (7) You should be able to extend, or change, a problem situation by posing additional conditions or questions.

No technical information is included. Sample instructional tasks and student performances are included.

(TC# 500.6ONNATT)

Hall, Greg. ***Alberta Grade 9 Performance-Based Assessment—Math*****, 1992. Available from: Greg Hall, Student Evaluation Branch, Alberta Education, Box 43, 11160 Jasper Ave., Edmonton, AB T5K 0L2, Canada.**

The 1992 ninth grade math performance assessment used six stations with hands-on activities—students circulate through the stations. Testing time for each group of six students is 90 minutes. The six tasks involved rearranging squares to form different perimeters for the same area, measurement and mapping, surface area, collecting and graphing information, estimation, and combinations/permutations.

Responses were scored using an analytical trait system having two dimensions: problem solving and communication. Each trait was scored on a scale of 0 (totally misunderstood or blank) to 3 (readily understood the task, developed a good strategy, carried out the strategy and generalized the conclusion). A few *possible* student responses are included to illustrate scoring, but no *actual* student responses are included. No technical information is included.

(TC# 500.3ALBGRN)

Halpern, Diane (Ed.). ***Enhancing Thinking Skills in the Sciences and in Mathematics*****, 1992. Available from: Lawrence Erlbaum Associates, Publishers, 365 Broadway, Hillsdale, NJ 07642, (800) 926-6579.**

This book is not strictly about assessment. Rather, it discusses the related topics of "What should we teach students to do?" and "How do we do it?" The seven authors "criticize the conventional approach to teaching science and math, which emphasizes the transmission of factual information and rote procedures applied to inappropriate problems, allows little opportunity for students to engage in scientific or mathematical thinking, and produces inert knowledge and thinking skills limited to a narrow range of academic problems" (p. 118). In general, they recommend that teachers focus on the knowledge structures that students should know, use real tasks, and set up instruction that requires active intellectual engagement.

The authors give various suggestions on how to bring this about: instructional methods, videodiscs, group work, and a host more. The final chapter analyzes the various positions and raises theoretical issues.

(TC# 500.6ENHTHS)

Hartman, Charlotte. ***Mathematical Power Opens Doors*****, 1993. Available from: Vancouver School District, PO Box 8937, Vancouver, WA 98668, (206) 696-7011.**

These open-ended mathematics problems supplement multiple-choice tests of content. Pilots are being undertaken in several grade levels; however, we only have examples for grade 6.

The document we have contains: (1) a restatement of the "big" NCTM outcomes (problem solving, reasoning, communication, connections); (2) three sample problems, and (3) a scoring guide (five traits: problem solving, communication, reasoning, math concepts and math procedures). A personal communication indicated that materials are used in two phases. First, several problems are done in a group to model how to proceed. Then, students choose three of five problems to do individually. No technical information or sample student performances are included.

(TC# 500.3MATPOO)

Harvey, John G. ***Mathematics Testing With Calculators: Ransoming the Hostages.*** **Located in: Mathematics Assessment and Evaluation: Imperatives for Mathematics Educators, Thomas A. Romberg (Ed.), 1992. Available from: State University of New York Press, State University Plaza, Albany, NY 12246.**

This paper looks at the use of calculators in mathematics testing. The premise is that if we want students to investigate, explore and discover, assessment must not just measure mimicry math. Tests designed to ***require*** calculators are more likely to be able to do this. Additionally, it is important to incorporate calculators into the curriculum because in the technological world of the future, calculators will be essential. If we want teachers to use calculators in instruction, we need to incorporate them into testing. The author analyzes three types of test with respect to calculator use, describes things to consider when designing calculator tests, and describes current activity in developing "calculator-active" tests.

(TC# 500.6MATTEC)

Herman, Joan L., Davina C. D. Klein, Sara Wakai, et al. ***Assessing Equity in Alternative Assessment: An Illustration of Opportunity-to-Learn Issues*, 1995. Available from: CRESST-UCLA, 10880 Wilshire Blvd., Suite 700, Los Angeles, CA 90024, (310) 206-1532, fax (310) 794-8636.**

This paper was presented at the April 19, 1995 annual meeting of the American Educational Research Association.

As part of the administration of the 1993 California Learning Assessment System (CLAS), samples of teachers and students were surveyed to examine "opportunity to learn"—the extent to which students have equal access to resources, quality instruction, extra-school opportunities, and preparation for the CLAS. Researchers sampled 13 schools from rural, urban, and suburban areas. The study included 27 teachers and over 800 students in eighth grade math classes.

Survey, interview, and classroom observation forms are included. Questions include such things as: use of calculators, use of open-ended questions, practice with explaining thinking, and attitudes toward math. The paper concludes that there are differences among school types on some of these factors.

(TC# 500.6ASSEQA)

Hibbard, K. Michael. ***Self-Assessment Using Performance Task Assessment Lists*, 1994. Available from: Region 15 School District, PO Box 395, Middlebury, CT 06762, (203) 758-8250.**

Pomperaug Regional School District 15 (Middlebury, CT) has developed performance criteria for a wide variety of student products and performances. These criteria, called "task assessment lists" are written to be developmentally appropriate for various grade levels (primary, elementary, and secondary). The lists are used to communicate to students the attributes of quality products and performances, promote student self-assessment and self-reflection, and grading. This document contains sample task assessment lists for graphs.

(TC# 500.3SELUSP)

Horn, Kermit, and Marilyn Olson. ***1992-1993 Lane County Fourth Annual Project Fair. Official Guidelines, Criteria & Registration Forms for Grades K-12.*** **Available from: Kermit Horn or Marilyn Olson, Project Fair Coordinators, Lane Education Service District, Instructional Services Division, PO Box 2680, Eugene, OR 97402, (503) 689-6500.**

This handbook is given to students (grades K-12) interested in registering for the Lane County project fair. It contains information on registration, criteria by which projects will be judged, and help with getting started. The document also gives some excellent ideas on interdisciplinary projects. No samples that illustrate score points on criteria are included; the criteria, although an excellent start, are still a little sketchy.

(TC# 000.3LANCOP)

Hynes, Michael C. *K-5 Mathematics Program Evaluation - A Florida Model Curriculum Project; School Handbook*, 1993. Available from: University of Central Florida, College of Education, Orlando, FL 32816, (407) 823-6076.

This handbook is intended to provide schools with the tools to assess K-5 mathematics programs in terms of student outcomes, program goals, curriculum, learning environment, learning resources, program support, evaluation, and equal access. The handbook includes sample instruments for each area. Most of these are surveys except for assessment of student outcomes.

Seventeen sample performance tasks (eight for primary and nine for grade 5) are included to assess various student outcome goals. These are open-ended (there is more than one correct answer) and most require explanations of, and rationale for, procedures used. Tasks do not use manipulatives—all are written/visual. All tasks are done individually; there is no group collaboration. Performance is rated using a generic four-point scale—"Exemplary (Level A)" to "No Attempt (Level E)." An Exemplary response is one which: "Provides excellent responses in all areas of problem solving, reasoning, communication, connections, and mathematics content. Goes beyond the excellent category. Shows creative thinking, elegant communication, and/or unique approaches to the problem. Uses additional information to extend the solution." A sample student response for each score point is included to illustrate the scoring procedure.

The handbook includes a disk containing each of the instruments, a "School Report Card" and the scoring rubric. No technical information is included. The author has granted permission for educators to reproduce materials for use with students.

(TC# 500.3K-5MAP)

Illinois State Board of Education. *Effective Scoring Rubrics—A Guide to Their Development and Use*, 1995. Available from: Illinois State Board of Education, Dept. of School Improvement Services, School and Student Assessment Section, 100 N. First St., Springfield, IL 62777, (217) 782-4823, fax (217) 784-6125.

This short booklet provides a good overview of the characteristics of sound performance criteria (rubrics, scoring guides) and uses Illinois' writing and math rubrics as examples. The author values analytic/holistic, developmental, generalizable rubrics for the classroom.

(TC# 150.6EFFSCR)

Illinois State Board of Education. ***Performance Assessment in Mathematics: Approaches to Open-Ended Problems*****, 1995. Available from: Illinois Educational Service Center Six, 1819 W. Pershing Rd., 4C(s), Chicago, IL 60609.**

This document is a very concise and well written guide for assessing problem solving using open-ended problems. The document includes a nice definition of problem solving, criteria for writing open-ended problems (with samples illustrating different types), a sample three-trait rubric (math knowledge, strategic knowledge, and communication) for scoring student work, and 41 scored samples. No technical information is included.

(TC# 500.6PEROPE)

Johnson, Judi Mathis. ***Portfolio Assessment in Mathematics: Lessons from the Field.*** **Located in: The Computing Teacher 21, March 1994, pp. 22-23.**

The author describes the results of a study in which she interviewed 20 successful math teachers. Her major conclusion is that math, assessment, and technology should not be competitors for teachers' attention, but components of a successful math classroom. Portfolios are used to both document and promote student learning and student responsibility for learning through self-reflection. Technology is used to learn concepts, produce work for the portfolios, and to produce the portfolio itself. Assessment is used to guide planning and influence instruction.

(TC# 500.6PORMAL)

Katims, Nancy. ***PACKETS® Program: An Illustration of Classroom-Based Alternative Assessment.*** **Available from: Director, Office of School Services, Educational Testing Service, Princeton, NJ 08541, (609) 921-9000, fax: (609) 734-5410.**

The author describes the *PACKETS®* mathematics performance assessment exercises for grades 6-8, under development by Educational Testing Service (ETS). The document includes the rationale for the approach taken, two extended examples with samples of student work, and suggestions on how to use the samples in the classroom.

PACKETS® activities try to pose a "big ideas" math problem in the context of developing a product for a client. Students read a context-setting newspaper article, discuss a set of readiness questions, and work together in groups of three for about two class periods. Students write-up their solutions and present them to the class. Students have the opportunity to revise after initial evaluation. Scoring is based on teacher observations (of group work and mathematical thinking) during the process of doing the activity; analyzing the math used; and evaluating the product for mathematical appropriateness, reasonableness of the solution, and appropriateness for the stated purpose. The document contains no scored student work and no technical information.

(TC# 500.3PACKET)

Kentucky Department of Education. *Kentucky Instructional Results Information System (KIRIS)*, 1993-94. Available from: Kentucky Department of Education, Division of Accountability, 1900 Capital Plaza Tower, 500 Mero St., Frankfort, KY 40601, (502) 564-4394.

The *Kentucky Instructional Results Information System* is an assessment program that monitors student achievement (grades 4, 8, and 12) in reading, social studies, science, and mathematics. The assessment has three parts: multiple choice/short essay, performance assessment, and portfolios. Assessment results place students in one of four performance levels: novice, apprentice, proficient, or distinguished. The document we received contains grade 4, 8, and 12 performance assessment items in reading, social studies, science, and mathematics. All items are paper and pencil. Task-specific scoring guides are included.

(TC# 060.3KIRIS94)

Khattri, Nidhi. *Performance Assessments: Observed Impacts on Teaching and Learning*, 1995. Available from: Pelavin Associates, 2030 M St. NW, No. 800, Washington, DC 20036.

The a . attempted to document the impact of performance assessment on teaching and learnir The author visited 14 schools in fall 1994 and spring 1995 to examine student work; obser in classrooms; and interview school personnel, students, and parents.

> The two strongest conclusions to be drawn from these findings are that: (1) students are being asked to write, to do project-based assignments, and to engage in group learning due to the use of performance assessments; and (2) as a result of project-based assignments, students are more motivated to learn. Furthermore, because of the use of performance-based assignments and the degree of freedom accorded to students in shaping their own work, collaboration also is evident. Increasingly, teachers are viewing students as active learners.
>
> All of the observed and reported effects, it must be emphasized, were mediated to a large degree by: (a) the form of the assessment (e.g., portfolio or performance event); (b) the degree of integration of the assessment into the classroom; and (c) the level of support provided to incorporate the assessment into routine classroom activities. The positive and intended effects on pedagogy are most evident for sites engaged in portfolio assessments, mostly because the portfolio format provides teachers and students control over products coupled with a structure for documenting student work and student progress on an ongoing basis.

The author states: "Performance assessments, thus, remain a *lever* for reform, but what exactly is to be leveraged still remains to be defined."

(TC# 150.6PERASO)

Kloosterman, Peter, and Frances K. Stage. ***Measuring Beliefs About Mathematical Problem Solving.*** **Located in: <u>School Science and Mathematics</u> 92, March 1992, pp. 109-115.**

The authors describe the development of a scale to assess student beliefs about mathematics. The instrument, designed for grades 7+, is called the *Indiana Mathematics Beliefs Scale.* Thirty-six questions cover six beliefs: (1) I can solve time-consuming mathematics problems (2) There are word problems that cannot be solved with simple, step-by-step procedures. (3) Understanding concepts is important in mathematics. (4) Word problems are important in mathematics (5) Effort can increase mathematical ability. (6) Mathematics is useful in daily life The paper includes technical information based on studies with college students.

(TC# 500.3MEABEM)

Knight, Pam. ***How I Use Portfolios in Mathematics,*** **1992. Located in: <u>Educational Leadership</u> 49, pp. 71-72. Also available from: Twin Peaks Middle School, Poway Unified School District, 14012 Valley Springs Road, Poway, CA 92064.**

The author describes her first year experimentation with portfolios in her middle school algebra classes. She had her students keep all their work for a period of time and then sort through it to pick entries that would best show: (1) effort and learning in algebra, and (2) activities that had been the most meaningful. There is some help with what she did to get started, and discussion of the positive effects on students. There is some mention of performance criteria, but no elaboration. One student self-reflection is included, but no technical information.

(TC# 530.3HOWIUS)

Koretz, Daniel, Daniel McCaffrey, Stephen Klein, et al. ***The Reliability of Scores from the 1992 Vermont Portfolio Assessment Program—Interim Report,*** **December 1992. Available from: RAND Institute on Education and Training, National Center for Research on Evaluation, Standards, and Student Testing, UCLA Graduate School of Education, 10880 Wilshire Blvd., Los Angeles, CA 90024, (310) 206-1532.**

Beginning in 1990, RAND has been evaluating Vermont's portfolio assessment program. This paper reports on the study conducted during school year 1991-92. Basically, RAND found that interrater agreement on portfolio scores was very low for both writing and math. The authors speculate that this resulted from aspects of the scoring system, aspects of the operation of the program, and the nature and extent of training raters. This report provides good advise and caution for others setting up portfolio systems for large-scale assessment. (Note: A paper published in 1995 reports that with better training, scoring becomes more reliable.)

(TC# 150.6RELSCV)

Koretz, Daniel, Brian Stecher, and Edward Deibert. ***The Vermont Portfolio Assessment Program: Interim Report on Implementation and Impact, 1991-92 School Year.*** **Available from: RAND Institute on Education and Training, National Center for Research on Evaluation, Standards, and Student Testing, UCLA Graduate School of Education, 10880 Wilshire Blvd., Los Angeles, CA 90024, (310) 206-1532.**

Beginning in 1990, RAND has been carrying out a multi-faceted evaluation of Vermont's portfolio assessment program. This paper reports on questionnaires and interviews conducted during school years 1990-91 and 1991-92. Results indicated that:

1. There was a significant impact on instruction, but teachers felt somewhat confused about what they were supposed to do.

2. The portfolios took a lot of classroom space and tended to be viewed by teachers as an add-on rather than as "the" instruction.

3. Teachers felt they knew more about students as the result of doing portfolios.

4. Students had some difficulty doing portfolio problems.

5. Reported effect on low achieving students was mixed.

(TC# 150.6VERPOP)

Koretz, Daniel, Brian Stecher, Stephen Klein, et al. ***The Vermont Portfolio Assessment Program: Findings and Implications.*** **Located in: Educational Measurement: Issues and Practice 13, Fall 1994, pp. 5-16.**

The authors describe the Vermont portfolio assessment system, summarize key findings from a series of evaluations of the Vermont system, and discuss the implication of the findings for performance assessment in general. Although somewhat technical, the paper clearly points out the reliability and validity concerns surrounding the use of portfolios for large-scale assessment, and the tensions between using portfolios for large-scale assessment and using portfolios for instructional improvement. In short, portfolios are not magic and they have to be thoughtfully implemented. The paper presents a very thoughtful discussion of the issues.

(TC# 000.6VERPOF)

Kulm, Gerald. (Ed.) ***Assessing Higher Order Thinking in Mathematics*****, 1990. Available from: American Association for the Advancement of Science, 1333 H Street NW, Washington, DC 20005, (301) 645-5643.**

This book contains a series of articles that address various topics in mathematics assessment. The articles address three broad topics:

1. The rationale for assessing mathematics problem solving and the need to have assessment devices that reflect this emphasis.

2. Issues that come up when trying to assess higher-order thinking skills in mathematics.

3. General discussions of what to assess and how to assess it.

There are a few examples of actual assessment techniques. The most relevant articles are included on this bibliography as separate entries.

(TC# 500.6ASSHIO)

Kulm, Gerald. ***Mathematics Assessment—What Works in the Classroom*****, 1994. Available from: Jossey-Bass Inc., Publishers, 350 Sansome St., San Francisco, CA 94104.**

This excellent book provides a good background for changes in assessment, has a great chapter on scoring rubrics, and provides good case studies of classroom alternative assessment use in grades 4-12.

(TC# 500.6MATASW)

Lambdin, Diana V. and Vicki L. Walker. ***Planning for Classroom Portfolio Assessment.*** **Located in: Arithmetic Teacher, February 1994, pp. 318-324.**

The authors report on the development of a portfolio system for their secondary mathematics students. (This was part of a larger project for all grade 3-12 teachers.) The authors have students assemble a "permanent portfolio" from a "working portfolio." The working portfolio is a place to store all potential permanent portfolio entries. The permanent portfolio is assembled from the working portfolio. The goals are to promote student self-assessment, improve communication with students and parents, and gain a broader picture of the student than available with traditional tests. The goal is *not* to assess the breadth of student knowledge—this is done with traditional methods. The authors include task guidelines that are given to students.

In addition to student and peer evaluation of portfolio selections and the portfolio as a whole, the teacher has guidelines for grading based on diversity of selection, quality of written reflections about selections, and portfolio organization. The authors present a little detail that flesh out these criteria. The document includes some student work but no technical information.

(TC# 500.3PLAPOA)

ERIC

Lane, Suzanne. ***QUASAR Cognitive Assessment Instrument, (QCAI)*, 1993. Available from: QUASAR (Quantitative Understanding: Amplifying Student Achievement and Reasoning), Learning Research & Development Center, University of Pittsburgh, 3939 O'Hara St., Pittsburgh, PA 15260, (412) 624-7791.**

The QCAI (QUASAR Cognitive Assessment Instrument) is designed to measure long-term growth of students in math thinking and reasoning. Information for this review was taken from several different papers (all of which are bound together in our collection).

Thirty-three tasks were designed for sixth and seventh graders. The tasks were designed to provide a good sample of math thinking and reasoning skills by using a variety of representations, approaches and problem strategies. Students were asked to provide a justification for a selected answer or strategy, explain or show how an answer was found, translate a problem into another representation (picture or equation), pose a mathematical question, interpret provided data, and extend a pattern and describe underlying regularities. The tasks were field-tested. General descriptions for all the tasks and details on a few individual tasks are provided in these materials.

Scoring is done via a generalized holistic, four-point rubric which directs raters to consider mathematical knowledge, strategic knowledge and communication. (Each of these dimensions is laid out very clearly and could be used as the basis of an analytical trait scoring scale.) The generalized rubric is then tailored to individual problems by specifying features of responses that would fall at different scale points. The generalized scoring guide is included in these materials but not the task-specific adaptations.

(TC# 500.3QUACOA)

Larter, Sylvia. ***Benchmarks: The Development of a New Approach to Student Evaluation*, 1991. Available from: Toronto Board of Education, 155 College St., Toronto, ON M5T 1P6, Canada, (416) 598-4931.**

Benchmarks are student performances on tasks tied to Provincial educational goals. Each Benchmark activity lists the goals to be addressed, the task, and the scoring system. Tasks vary considerably. Some require very discrete responses (e.g., knowledge of multiplication facts), while others are more open-ended. There are 129 Benchmarks developed in language and mathematics for grades 3, 6, and 8.

For many of the tasks, a general, holistic, seven-point scale ("no response" to "exceptional performance [rare]") was used as the basis to develop five-point, task-specific, holistic scoring scales. For other tasks, scoring appears to be right/wrong. Holistic scoring emphasizes problem solving, method of production, process skills, and accuracy, although students can also be rated on perseverance, confidence, willingness, and prior knowledge, depending on the Benchmark.

The percentage of students at each score point (e.g., 1-5) is given for comparison purposes, as are other statistics (such as norms) when appropriate. Anchor performances (e.g., what a "3" performance looks like) are available either on video or in hard copy. This report describes the philosophy behind Benchmarks, how they were developed, and a few of the specific Benchmarks. Some technical information is described (factor analysis, rater agreement), but no student performances are provided.

(TC# 100.6BENCHM)

Lawrence, Barbara. ***Utah Core Curriculum Performance Assessment Program: Mathematics*****, 1993. Available from: Profiles Corporation, 507 Highland Ave., Iowa City, IA 52240.**

The Utah State Office of Education has developed 90 constructed-response items in mathematics, science and social studies (five in each of grades 1-6 for each subject) to complement multiple-choice tests already in place. Assessments are designed to match the Utah Core Curriculum goals. Although districts are required to assess progress toward these goals, the state-developed assessments are optional.

The mathematics assessments are designed to measure logical reasoning, number meanings, number operations, number representation, computation, estimation, algebra, data sets, probability, geometry, measurement, fractions, and patterns. Each task has several questions relating to a theme. For example, a sixth grade task called "Lab Tech" has students do such things as: complete a number sequence (adding milliliters to a chemical solution every 10 minutes), and "You need to plant two kinds of seeds. You must have 12 pots of one kind of seeds and 18 pots of the other kind of seeds. You need to plant the same total number of each kind of seed. What is the least number of each kind of seed you could plant?"

Scoring is task-specific and based on the degree of correctness of the response. For example, in the "Lab Tech" example, the student gets 3 points if he or she correctly completes the entire sequence. Points are totaled for each task and between tasks for each of the skill areas being assessed. Four levels of proficiency on each skill are identified: advanced, proficient, basic and below basic. Cut scores for each level are based on percent correct (approximately 90%=advanced, 70%=proficient, 40%=basic, below 40%=below basic) and behavioral descriptions of performance at each level.

Assessment activities are bound in books for each grade level/subject. Each task includes teacher directions, student test-taking materials, and scoring guides. The Office of Education has collected information on teacher reaction to the assessments from the field test. No other technical information is available at this time. A training video is available which helps teachers use the assessments.

(TC# 500.3UTACOC AND 000.6INTUTCv—*video*)

Leach, Eilene L. ***An Alternative Form of Evaluation that Complies with NCTM's Standards.*** **Located in: <u>The Mathematics Teacher</u> 85, November 1992, pp. 628-632. Also available from Centaurus High School, 10300 S. Boulder Rd., Lafayette, CO 80026.**

This teacher uses scored discussions to assess and promote problem solving, communicating mathematically, and group process skills in her high school math classes. She has three to six students face each other in front of the rest of the class and spend about five minutes trying to solve a problem. Individuals can earn positive points for such things as "determining a possible strategy to use," "recognizing misused properties or arithmetic errors," or "moving the discussion along." They can earn negative points by doing such things as: "not paying attention or distracting others," and "monopolizing."

The article has a thorough discussion of how the teacher sets up the classroom, introduces the procedure to students, scores the discussion, and handles logistics. The author also discusses the positive effects this procedure has had on students, and the additional insight she has obtained about her students.

All scoring is teacher-centered, but it wouldn't necessarily have to be. No technical information is included.

(TC# 500.3ALTFOE)

Lehman, Michael. ***Assessing Assessment: Investigating a Mathematics Performance Assessment*****, 1992. Available from: The National Center for Research on Teacher Learning, 116 Erickson Hall, Michigan State University, East Lansing, MI 48824-1034.**

This monograph, by a high school math teacher, describes his attempt to develop a better method of assessing algebra problem solving, concepts, and skills than traditional paper-and-pencil tests. The assessment technique involves giving students problems to solve as a group, and then having them explain their results in front of a panel of judges. Three examples of problems are provided, as is a brief description of the scoring criteria (making sense of the problem, and problem-solving strategies), accuracy of results, interpreting results, ability to communicate results, and an explanation of what they did. However, these criteria are not elaborated on, and, although samples of student explanations are provided, these are used to describe the understandings the teacher reached about his students, not to anchor the performance criteria.

The author also provides a brief summary of the strategies he uses to help students develop greater depth in their understanding of algebraic principals and their interrelationships—small group cooperative learning, requiring justifications of approaches, etc.

(TC# 530.3ASSASI)

Lehman, Michael. ***Performance Assessment—Math*, 1992. Available from: Michael Lehman, Holt Senior High School, 1784 Aurelius Rd., Holt, MI 48842, (517) 694-2162.**

This paper is related to the one above, and provides additional information. Students are given six problems (some having only one right answer and some having more than one right answer) to solve as a team (four students per team). The team then spends an hour with a panel of three judges. Judges can ask any student to explain the team's solution and problem-solving strategy on any of the six problems. (Therefore, all students must have knowledge of all six problems.) Then the judges assign the team a new problem to work on while they watch.

Student responses are scored on: making sense of the problem, solution strategies, accuracy of results, ability to communicate results, ability to answer questions posed by the judges, three judgments of group-process skills, and an overall judgment of student understanding.

A complete set of ten tasks (six pre-assigned, and four on-the-spot) are included for Algebra II. The scoring guide and a few sample pre-calculus projects are also included. No technical information nor sample student performances are included.

(TC# 500.3PERASM)

Lesh, Richard. ***Computer-Based Assessment of Higher Order Understandings and Processes in Elementary Mathematics*. Located in: <u>Assessing Higher Order Thinking in Mathematics</u>, Gerald Kulm (Ed.), 1990. Available from: American Association for the Advancement of Science, 1333 H Street NW, Washington, DC 20005, (301) 645-5643.**

This article is as much about how meaningful learning occurs and the nature of the structure of knowledge in mathematics, as it is about use of computers in math instruction and assessment. The basic premise is that computer-based tests should not simply be pencil-and-paper tests delivered on-line. They should be part of an integrated instruction and assessment system that supports both learning facts and developing the meaningful internal structuring of these facts to form a coherent knowledge system.

The article discusses three things:

1. Principles underlying a modeling perspective of learning and assessment (ideas such as: learning and problem-solving situations are interpreted by the learner by mapping them to internal models, and several "correct" alternative models may be available to interpret a given situation)

2. Five objectives that should be emphasized in K-12 math (such as going beyond isolated bits of knowledge to construct well-organized systems of knowledge, and think about thinking)

3. Specific types of assessment items that can be used to measure these deeper and broader understandings (such as conceptual networks and interactive word problems)

Many sample problems are provided.

(TC# 500.6COMBAA)

Lesh, Richard and Susan J. Lamon, Eds. ***Assessment of Authentic Performance in School Mathematics*****, 1992. Available from: American Association for the Advancement of Science, 1333 H St. NW, Washington, DC 20005.**

This book contains articles by several authors on the topics of: assessment objectives—what should we assess; examples of assessments; classroom assessment; and scoring and reporting.

(TC# 500.6ASSAUP)

Lester, Frank K, Jr. ***An Assessment Model for Mathematical Problem Solving.*** **Located in: <u>Teaching Thinking and Problem Solving</u> 10, September/October, 1988, pp. 4-7. Also available from: Lawrence Erlbaum Associates, Inc., Journal Subscription Department, 365 Broadway, Hillsdale, NJ 07642, (800) 962-6579**

This article presents a model for assessing both the problem-solving performance of students and assessing the task demands of the problem to be solved. The dimensions of problem solving (which could be used as a scoring rubric) are: understanding/formulating the question in a problem, understanding the conditions and variables in the problem, selecting the data needed to solve the problem, formulating subgoals and selecting appropriate solution strategies to pursue, implementing the solution strategy and attaining subgoals, providing an answer in terms of the data in the problem, and evaluating the reasonableness of an answer. The article describes these in some detail.

The problem features that can affect a student's success in solving a problem are: the type of problem, the strategies needed to solve it, the mathematical content/types of numbers used, and the sources from which data need to be obtained to solve the problem.

(TC# 500.3ANASSM)

Lester, Frank K. Jr., and Diana Lambdin-Kroll. ***Assessing Student Growth in Mathematical Problem Solving.*** **Located in: <u>Assessing Higher Order Thinking in Mathematics</u>, Gerald Kulm (Ed.), 1990. Available from: American Association for the Advancement of Science, 1333 H Street NW, Washington, DC 20005, (301) 645-5643.**

The authors present a model of factors that influence problem-solving performance, and discuss several problem-solving assessment techniques.

A good assessment program in math should collect information about the following: affect (attitudes, preferences, and beliefs), and cognitive/processes ability to get the right answer (both whether they get the right answer, and the strategies used). The program should also systematically define and cover the features of tasks (problem type, math content, required strategies, etc.) since these affect performance and should be reflected in instruction.

In order to gather information on these three categories of factors, the authors briefly review observations, interviews, student self-reports, and holistic and analytic scoring of performances. They recommend against multiple-choice questions.

This paper is a general theoretical discussion, no actual tasks, problems or scoring guidelines are provided.

(TC# 500.6ASSSTG)

Linn, Robert L., Elizabeth Burton, Lizanne DeStefano et al. ***Generalizability of New Standards Project—1993 Pilot Study Tasks in Mathematics*****, 1995. Available from: Center for Research on Evaluation, Standards, and Student Testing, School of Education, University of Colorado, Campus Box 249, Boulder, CO 80309, (303) 492-8280.**

The authors report on a study in which they examined the ability to draw general conclusions about student skills from a small sample of performances. They repeat the finding that more error is introduced into assessment results from the sample of tasks the student gets than from inconsistencies between raters when scoring. In other words, it is difficult to infer general student skill level from performance on a small number of tasks because student performance is not very consistent from task to task.

(TC# 150.6GENNES)

Madaus, George F. and Thomas Kellaghan. ***The British Experience with 'Authentic' Testing*****. Located in: Phi Delta Kappan 74, February 1993, pp. 458-459, 462-463, 466-469.**

This paper presents a good summary of the performance assessment approach in England and results of the age 7 assessment in math, science, and language arts:

- technical problems
- lots of stress
- high cost
- hard to manage

Nevertheless, there was value, and most staff felt it gave them food for thought about instructional practice. England is retreating from its approach.

(TC# 000.6BRIEXA)

Marshall, Sandra P. ***Assessing Knowledge Structures in Mathematics: A Cognitive Science Perspective.*** **Located in: Cognitive Assessment of Language and Mathematics Outcomes, Sue Legg & James Algina (Eds.), 1990. Available from: Ablex Publishing Company, 355 Chestnut St., Norwood, NJ 07648.**

This article discusses the implications of recent advances in cognitive science for mathematics assessment. The goal in using this research to develop assessment techniques is to determine the extent to which students have acquired specific cognitive skills rather than merely whether they can correctly solve particular problems.

Cognitive theory holds that people solve problems by using three knowledge structures—declarative (facts), procedural (algorithms and production rules), and schema (frames that relate facts and production rules). To solve a problem, a person must first find the right schema, must then correctly implement a set of production rules, and must have stored correctly the facts and knowledge required to carry out the necessary algorithms specified by the production rules. Errors can occur in any of these three areas.

Researchers are currently engaged in specifying these knowledge structures in such detail that they can develop computer simulations that can, first, solve problems, and second, reproduce student errors by leaving out or altering various parts of the necessary structures. In this way, errors in student responses can be tracked back to the erroneous structure used. The author specifically mentions work in the area of simple arithmetic operations, geometry, and word problems.

Additionally, the author discusses two other ways of assessing these things in students—reaction time (to assess how automatic a function is); and multiple-choice problems (e.g., "which of the following problems can be solved in the same way as the one stated above?" to get at schema knowledge). Some time is spent with multiple-choice problems to explore various types of problems and the technical issues that arise with them.

It should be pointed out that all these procedures are experimental; none have progressed to the point where there is a final product that can be ordered and installed.

(TC# 500.6ASSKNS)

Marshall, Sandra P. ***The Assessment of Schema Knowledge for Arithmetic Story Problems: A Cognitive Science Perspective*****, 1990. Located in: Assessing Higher Order Thinking in Mathematics, Gerald Kulm (Ed.). Available from: American Association for the Advancement of Science, 1333 H Street NW, Washington, DC 20005, (301) 645-5643.**

The *Story Problem Solver* (SPS) was created to support instruction based on a theory of memory architecture called schemata. Under such theories, human memory consists of networks of related pieces of information. Each network is a schema—a collection of well-connected facts, features, algorithms, skills, and/or strategies.

Adult students are explicitly taught five problem-solving schemas and how to recognize which schema is represented by a story problem. SPS is a computerized assessment method in which several different item types are used: students pick out the schema or general solution strategy that fits a given story problem, decide which information in the story problem fits into the various frames of the schema, identify the steps needed to solve a problem, and decide whether the necessary information is given in the problem.

Some of the schema shells and item types are given as examples. No technical information is included.

(TC# 500.3ASSOFS)

Maryland Assessment Consortium. *Information Packet*, 1993-94. Available from: Jay McTighe, Maryland Assessment Consortium @Frederick County Public Schools, 115 E. Church St., Frederick, MD 21701, (301) 694-1337, fax (301) 694-1800.

This handout contains an overview of the Maryland Assessment Consortium and two sample elementary assessment tasks. The first is an integrated task (social studies, science, and writing) which requires students to compose an "Aesop's Fable" after reading and analyzing such fables and discussing where they come from. The second is a math activity on planning a backpacking trip. Some scoring guides are task specific and others are generalized. Task-specific scoring tends to be used for knowledge questions and generalized scoring tends to be used for "big" outcomes such as problem solving. No student work or technical information is included.

(TC# 000.3MARASC)

Maryland Assessment Consortium. *Performance Assessment Tasks Elementary Level, Volume 6* and *Performance Assessment Tasks Middle School, Volume 7*, 1994-95. Available from: Jay McTighe, Maryland Assessment Consortium @Frederick County Public Schools, 115 E. Church St., Frederick, MD 21701, (301) 694-1337, fax (301) 694-1800.

The Maryland Assessment Consortium has published two notebooks of sample performance tasks in language arts, science, social studies, and mathematics. Some tasks are integrated across these areas. *Volume 6* contains 13 elementary tasks and *Volume 7* contains 9 middle school tasks. Each task includes complete instructions, test booklets and scoring guide, extension activities, special education modifications, and references. Many tasks require several steps or portions related to a theme, group work, hands-on activities, reading and interpreting materials, and writing in subject matter areas. Performance criteria tend to be task-specific with separate criteria for each part of the task.

All tasks have been pilot-tested. No technical information nor sample student work are included. This document includes one sample elementary task and one sample middle school task. Full sets are available from the author

(TC# 000.3PERAST,

Maryland Department of Education. ***Maryland School Performance Assessment Program,*** **1992. Available from: Gail Lynn Goldberg, Maryland Department of Education, Maryland School Performance Assessment Program, 200 W. Baltimore St., Baltimore, MD 21201, (410) 333-2000.**

Maryland has released six performance tasks that illustrate the 1992 assessment. This review is based on three of them, one task at each of grades 3, 5 and 8. The tasks are integrated across subject areas and use some combination of information and skills in science, math, writing, reading, and social studies. The three tasks we have relate to the weather (Grade 3), snowy regions of the country (Grade 5) and collisions (Grade 8). Each task has both individual and group work and proceeds through a series of exercises that require reading, designing and conducting experiments, observing and recording information, and writing up results.

Student responses are scored using two basic approaches: generalized holistic or analytical trait scoring for the "big" outcomes such as communication skills, problem solving, science process skills, and reasoning; and specific holistic ratings of conceptual knowledge and applications. For example, the task on collisions is scored both for knowledge of the concepts of mass and rate/distance, and for general science process skills (collecting and organizing data, and observation) and communication skills. Thus, some scoring guides are generalized across tasks, and some list specific features from individual tasks to watch for.

The materials we have allude to anchor performances and training materials, but these are not included in our samples. Neither information about student performance, nor technical information about the tests is included.

(TC# 060.3MARSCP)

Maryland State Department of Education. ***Maryland School Performance Assessment Program: Resource Library—MSPAP Public Release Tasks: Planning a Zoo, Grade 3, Mathematics; School Fair, Grade 5, Mathematics;*** **and** ***Birth Dates, Grade 8, Mathematics;*** **July 1994. Available from: Maryland State Department of Education, Maryland School Performance Assessment Program, 200 W. Baltimore St., Baltimore, MD 21201, (410) 333-2000.**

This document contains a 1994 released math assessment booklet and scoring guide for each of grades 3, 5, and 8. Booklets consist of a scenario around which several related math activities are structured. For example, at grade 8 there are several questions related to the theme of birthdays. Some questions require only a short answer while others require more complex responses, e.g., drawing a graph, writing an explanation of an answer, or making predictions. Scoring is task-specific.

The document contains tasks and scoring guides complete with sample student responses. No technical information is included.

(TC# 500.3MSPAPM)

Maryland State Department of Education. *Scoring MSPAP (Maryland School Performance Assessment Program): A Teacher's Guide*, 1993. Available from: Gail Lynn Goldberg, Maryland Department of Education, Maryland School Performance Assessment Program, 200 W. Baltimore St., Baltimore, MD 21201, (410) 333-2000.

This document presents information about the 1993 MSPAP in grades 3, 5, and 8: philosophy, general approach, sample tasks, and performance criteria. There are sample tasks, performance criteria and student responses for the following areas: expository, persuasive and expressive writing, reading comprehension, math, science, and social studies.

Scoring can be done three different ways depending on the task: generalized scoring rubrics that can be used across tasks (e.g., persuasive writing); generalized scoring rules that are not as detailed as rubrics (e.g., language usage); and scoring keys that are task-specific (e.g., many math tasks are scored for the degree of "correctness" of the response)

No technical information is included.

(TC# 000.3SCOMST)

Maryland State Department of Education. *Teacher to Teacher Talk: Student Performance on MSPAP (Maryland School Performance Assessment Program)*, 1992. Available from: Gail Lynn Goldberg, Maryland Department of Education, Maryland School Performance Assessment Program, 200 W. Baltimore St., Baltimore, MD 21201, (410) 333-2000.

This publication presents teacher reactions to their experience of scoring performance assessment tasks on the 1992 Maryland School Performance Assessment Program (MSPAP). The MSPAP covered reading, writing, math, social studies and science in grades 3, 5, and 8. Comments are organized by grade and subject. Most comments have to do with two topics: what teachers learned about students as the result of participating in the scoring, and how the performance tasks should be revised.

(TC# 000.6TEATET)

Marzano, Robert J., Debra J. Pickering, Jo Sue Whisler, et al. ***Authentic Assessment,*** **undated. Available from: Mid-Continent Regional Laboratory (McREL), 2550 S. Parker Rd., Suite 500, Aurora, CO 80014, (303) 337-0990.**

This document appears to be a series of handouts used in training. Although not specifically about math, the document does discuss some "big" outcomes related to math such as complex thinking, information processing, communication, etc

Materials include definitions of assessment terms, a procedure for developing performance assessment tasks, and samples of tasks and scoring guides. The general approach is mix and match—tasks are meant to elicit several target behaviors on the part of students which are then scored with generic performance criteria. For example, a problem-solving task requires students to draw a picture of their neighborhoods without using any circles or squares. Performances are scored for knowledge (geometry), complex thinking (ability to identify obstacles in the way of achieving desired outcomes), and effective communication (ability to express ideas clearly).

Sample tasks are in the areas of science, math and social studies. There are general mix-and-match scoring guides for: Knowledgeable Person, Complex Thinker, Information Processor, Effector Communicator/Producer, Self-Directed Learner, and Collaborative Worker. Scoring guides are generally not very descriptive. For example, one of the three traits included in the scoring guide for Skilled Information Processor is "effectively interprets and synthesizes information." To get a "4" (the highest score possible) the student "consistently interprets information gathered for tasks in accurate and highly insightful ways and provides synthesis of that information that are highly creative and unique." This is basically just a restatement of the trait title.

The authors have begun to develop a useful approach to performance assessment (mix-and-match tasks and performance criteria), but the criteria need to be filled out a little more.

(TC# 150.6AUTASS)

Massell, Diane. ***Setting Standards in Mathematics and Social Studies.*** **Located in: <u>Education and Urban Society</u> 26, February 1994, pp. 118-140.**

This article describes, analyzes, and contrasts two efforts to set curriculum standards—the National Council of Teachers of Mathematics (NCTM) efforts in math, and the state of California's efforts in history-social studies. It describes the history of development and provides ideas on what it takes to have a successful development effort.

(TC# 000.5SETSTM)

Mathematical Science Education Board, National Research Council. *Measuring Up—Prototypes for Mathematics Assessment*, 1993. Available from: National Academy Press, 2101 Constitution Ave, NW, Washington, DC 20418, (800) 624-6242.

Measuring Up is designed to illustrate performance assessment tasks that could be used with fourth graders to support reform efforts in mathematics instruction. The book presents 13 prototype assessments which are meant to be examples of assessment possibilities, not examples of ready-to-use assessments that provide an adequate sample of the NCTM standards.

Each task description contains the following information: time allotment, student grouping, assumed background knowledge of students, task description, student materials, rationale/explanation, and "protorubric." The 13 assessments have the following features: (1) they take 1-3 class periods; (2) some require collaboration; (3) most require student explanations; (4) they present a series of questions related to a general activity; (5) most have a single correct or best response, although a few are more open-ended; and (6) some have Spanish translations.

Scoring is based on "protorubrics," beginning scoring guides that are not yet fully fleshed out. All are task-specific and use a three-point scale—high, medium, or low response. Abstracting across "protorubrics," the following types of things are included in the "high" category: correctness of response, evidence of conceptual understanding, flexibility of thinking, clarity of presenting results, and problem solving. (However, the "protorubrics" do not themselves identify their own content in this manner, nor do all include everything on this list.) The "protorubrics" are not, in themselves, sufficient to interpret results; the "rationale" section for each assessment is also necessary.

Tasks were pilot-tested to ensure that they work as intended. No other technical information is available. Many samples of student responses are included.

(TC# 500.3MEAUPP)

McDonald, Joseph P., Sidney Smith, Dorothy Turner, et al. *Graduation by Exhibition—Assessing Genuine Achievement*, 1993. Available from: Association for Supervision and Curriculum Development, 1250 N. Pitt St., Alexandria, VA 22314, (703) 549-9110, fax (703) 549-3891.

This book describes a strategy for school reform called "planning backwards from exhibitions." In this approach, schools define a vision of what they want for graduates by proposing a task they want graduates to do well. Having set the vision, they have students perform the task and compare the vision against actual performance. Then they plan backwards what students would need to know and be able to do at various grades or ages in order to be able to do well on the task.

This booklet describes this process with three case studies, each proposing a different task "platform" against which they guage student success—writing a position paper, inquiring and presenting, and participating in discussion seminars.

(TC# 150.6GRAEXA)

McTighe, Jay. ***Developing Performance Assessment Tasks: A Resource Guide,*** **October 1994. Available from: Maryland Assessment Consortium, c/o Frederick County Public Schools, 115 E. Church St., Frederick, MD 21701, (301) 694-1337.**

This is a notebook of performance assessment "must reads." The authors have assembled their favorite papers on: definitions, overview of performance assessment, and designing performance tasks and criteria. The notebook also contains Maryland's learner outcomes.

(TC# 150.6DEVPEA)

McTighe, Jay. ***Maryland Assessment Consortium: A Collaborative Approach to Performance Assessment,*** **1991. Available from: Maryland Assessment Consortium, c/o Frederick County Public Schools, 115 E. Church St., Frederick, MD 21701, (301) 694-1337.**

This entry contains handouts from a presentation by the author in 1991. The following topics are covered:

1. A description of the consortium—what it is and what it does.

2. An overview of the process used for developing performance tasks, and review criteria for performance tasks.

3. Examples of three performance assessment tasks developed by the consortium: one math problem-solving task for grade six and two fifth grade reading tasks. All tasks are scored using a four-point holistic scoring guide. Scoring appears to be generalized rather than tied to individual tasks. The reading tasks, for example, are scored using the same, generalized scoring guide.

(TC# 500.3MARASC)

McTighe, Jay. ***Teaching and Testing in Maryland Today: Education for the 21st Century,*** **1992. Available from: Maryland Assessment Consortium, c/o Frederick County Public Schools, 115 E. Church St., Frederick, MD 21701, (301) 694-1337.**

This 13-minute video is designed to introduce parents and community members to performance assessment.

(TC# 150.6TEATEMv)

Mead, Nancy. ***IAEP (International Assessment of Educational Progress) Performance Assessment (Science and Math)*, 1992. Available from: Educational Testing Service, Rosedale Rd., Princeton, NJ 08541, (609) 734-1526.**

This document supplements the report by Brian Semple (also described in this bibliography) (TC# 600 6PERASS) The document contains the administrators manual, scoring guide, equipment cards, and released items from the Second International Assessment of Educational Progress in science and mathematics.

(TC# 500.3IAEPPA)

Medrich, Elliott A., and Jeanne E. Griffith. ***International Mathematics and Science Assessments: What Have We Learned?*, 1992. Available from: National Technical Information Service, US Department of Commerce, 5285 Port Royal Rd., Springfield, VA 22161. (703) 487-4650.**

This report provides a description of the international assessments of math and science (First International Mathematics and Science Studies, 1960's; Second International Mathematics and Science Studies, 1980's; and First International Assessment of Educational Progress, 1988), some of their findings, and issues surrounding the collection and analysis of these data. It also offers suggestions about ways in which new data collection procedures could improve the quality of the surveys and the utility of future reports.

(TC# 000.6INTMAS)

Meltzer, L. J. ***Surveys of Problem-Solving & Educational Skills*, 1987. Available from: Educator's Publishing Service, Inc., 75 Moulton St., Cambridge, MA 02138.**

Although this is an individual test published primarily for diagnosing learning disabilities for students aged 9-14, it has some interesting ideas that could be more generally applied. There are two parts to the test—a more-or-less standard individualized aptitude test, and a series of achievement subtests. The math subtest involves a fairly standard test of computation. The interesting part comes in the scoring. Each problem is scored on choice of correct operations, ability to complete the word problem, efficiency of mental computation, self-monitoring, self-correction, attention to operational signs, and attention to detail (one point for evidence of each trait).

After the entire subtest is administered, the teacher is guided through analysis of the student's strategies in completing the task—efficiency of approaching tasks, flexibility in applying strategies, style of approaching tasks, attention to the task, and responsiveness during assessment. (Each area is assigned a maximum of three points for the presence or absence of three specific features of performance. For example, under "efficiency" the students get a point if he or she does not need frequent repeating of instructions, a second point if the student implements the directions rapidly, and a third point if the student perseveres to complete the task.) Examples of scoring are included.

A fair amount of technical information is included. This covers typical performance, factor analysis, inter-rater reliability, relationship to other measures of performance, and comparison of clinical groups.

(TC# 010.3SUROFP)

Miller, Edward, Ed. ***The Push for New Standards Provokes Hope and Fear—and Both Are Justified.*** **Located in: The Harvard Education Letter 9, September/October 1993, pp. 1-6.**

The author's position is that new standards, in and of themselves, will not reform or improve American education in math. We also need to pay equal attention to developing teachers' skills and to providing all students with equal opportunity to learn. Roadblocks to *real* reform include: (1) outmoded tests; (2) lack of teacher sophistication in math; (3) pressure to cover all the material in textbooks; (4) lack of time for planning and learning; and (5) lack of materials and resources. The article also includes other topics such as the need for standards that emphasize different skills and not just attaining higher levels of traditional skills, lessons from other countries, and vignettes demonstrating the various points made in the article.

(TC# 500.5PUSNES)

Models of Authentic Assessment Working Group. ***Superitem Tests in Mathematics,*** **undated. Available from: National Center for Research in Mathematical Sciences Education, 1025 W. Johnson St., Madison, WI 53706, (608) 263-3605**

The document we received is a set of 20 open-response tasks that are designed to measure the statistics, measurement and geometry knowledge of middle school students (grades 7-9). Each of the 20 tasks has a set of four questions, each of which has only a single correct answer. From a sample problem, it appears that all responses are scored right/wrong using task-specific scoring guides.

The materials we received did not contain a description of which specific goals were covered by each question, sample student responses, scoring guides, contextual information, nor technical information.

(TC# 500.3SUPTM)

Mullen, Kenneth B. ***Free-Response Mathematics Test,*** **1992. Available from: American College Testing Program, PO Box 168, Iowa City, IA 52240, (319) 337-1051.**

This was a paper presented at the annual meeting of the National Council on Measurement in Education, San Francisco, April 1992.

This paper reports on a study by ACT that compares multiple-choice, open-response, and gridded response item formats on reliability, difficulty and discrimination. In gridded response items, students fill in "bubbles" that correspond to the answer rather than choosing the answer from a given list. "Testlets" were designed to cover the same content and have the same test length for each format. Results indicated that all formats had about the same reliability; there was good rater agreement on the open-ended problems; and grid and open-ended problems discriminated better between students with different achievement levels. The correlation between performances on the various types of items ranged from 0.5 to 0.7.

A few sample problems are provided. All open-response questions used scoring criteria that emphasize degree of correctness of the response and were tied to the task (i.e., there was a different scoring guide for each problem).

(TC# 500.3FREREM)

Mumme, Judy. *Portfolio Assessment in Mathematics*, 1990. Available from: California Mathematics Project, University of California—Santa Barbara, 522 University Rd., Santa Barbara, CA 93106, (805) 961-3190.

This booklet describes what mathematical portfolios are, what might go into such portfolios, how items should be selected, the role of student self-reflection, and what might be looked for in a portfolio. Many student samples are provided. Criteria for evaluating portfolios include: evidence of mathematical thinking, quality of activities and investigation, and variety of approaches and investigations. No technical information is included.

(TC# 500.6PORASI)

National Center for Research on Evaluation, Standards, and Student Testing (CRESST). *Assessing the Whole Child*, 1994. Available from: CRESST, Graduate School of Education, 145 Moore Hall, 405 Hilgard Ave., Los Angeles, CA 90024, (310) 206-1532.

This 17-minute video illustrates and describes one teacher's use of assessment in her third/fourth grade classroom. The teacher describes various assessment techniques, why she uses each, and what each shows about students. There are clips of how it looks when used in the classroom with students. The tape shows use of: standardized tests, performance assessment, conferences, journals, and projects. The tape also shows criteria for choosing materials for math portfolios, student self-reflection, and student self-assessment. The teacher's basic philosophy is that the more we know students, the better able we are to help each succeed. This is a high quality production.

(TC# 150.6ASSWHCt and TC# 150.6ASSWHCv)

National Council of Teachers of Mathematics. *Mathematics Assessment: Alternative Approaches*, 1992. **Available from: The National Council of Teachers of Mathematics, Inc., 1906 Association Dr., Reston, VA 22091.**

This 71-minute videotape and guide are for professional educators who want to try new approaches to assessment, as described in the book *Mathematics Assessment: Myths, Models, Good Questions and Practical Suggestions*, by Jean Stenmark (also on this bibliography, TC# 500.3MATASM). The video is divided into six segments that each require from 8-15 minutes of viewing time. Individual segments could be used during a sequence of teacher education or staff development meetings. The segments show challenges that confront teachers through the school year as they try new approaches to assessment. Classroom clips are included. Many suggestions are provided for how to follow-up each segment. (A copy of the book *Mathematics Assessment: Myths, Models, Good Questions and Practical Suggestions* is included with the video and guide when purchased.) Topics covered include:

- Goals of alternative assessment
- Characteristics of "authentic assessment"
- Designing and using good assessment tasks
- Writing in mathematics
- Using interviews and checklists
- Portfolios
- How to implement these ideas.

(TC# 500.6MATASAv)

National Science Foundation. ***Educating Americans for the 21st Century: A Plan of Action for Improving Mathematics, Science and Technology Education*, 1983. Available from: National Science Board Commission on Precollege Education in Mathematics, Science and Technology, Forms & Publications Unit, 1800 G St. NW, Room 232, Washington, DC 20550, (202) 357-3619.**

This is not strictly a document regarding assessment, but rather a statement of what students need to know and be able to do in science and math. As such, it also provides an outline for what assessments should measure.

(TC# 000.5EDUAMF)

Newmann, Fred M., Walter G. Secada, and Gary G. Wehlage. ***A Guide to Authentic Instruction and Assessment: Vision, Standards and Scoring,*** **1995. Available from: Wisconsin Center for Educational Research, School of Education, University of Wisconsin, 1025 W. Johnson St., Madison, WI 53706, (608) 263-4200.**

The authors' premise is that innovative teaching techniques (e.g., cooperative learning, group discussions, hands-on experiments and videos) do not guarantee a change in the "intellectual quality" of what students are asked to do. For example, "a portfolio that shows a variety of student work over a semester might replace the final exam taken in one sitting, but the portfolio itself could be filled with tasks" devoted to remembering and listing isolated bits of information. Thus, the merit of any teaching technique should be judged by its ability to improve the "intellectual quality of student performance."

The paper is devoted to defining "intellectual quality," developing criteria for judging the intellectual quality of the school work students are asked to perform, for judging the intellectual quality of assessment tasks, and for assessing the intellectual quality of student work. The criteria are designed for use in *any* content area and thus serve to define delivery and performance standards across the curriculum and across teaching methods. Specific examples of the criteria are provided in math and social studies. Some samples of student work are included.

(TC# 050.3GUIAUI)

Nicoll, Richard, Kathy Jacobson, Jim Rybolt. ***Curriculum-Based Alternative Assessment of Mathematics (CBAAM) [Third Grade and Sixth Grade] A Report to Teachers,*** **April 1993. Available from: Mt. Diablo Unified School District, 1936 Carlotta Dr., Concord, CA 94519, (510) 682-8000, ext. 4135.**

This review is based on reports of the 1993 third and sixth grade assessments. Students respond to three extended problems, some of which have right/wrong answers and some of which are more generative. For example, one third grade problem requires students to plan a city. Students are directed to list "buildings and places needed to have a working community," pick 8-10 from the list, place these on a map, and describe the rationale for the placement. Students do both group and individual work.

A generalized, holistic, six-point scoring guide is tailored to individual problems. In the generalized version, a "6" is: "complete response with a clear, coherent, unambiguous, and elegant explanation; includes a clear and simplified diagram when appropriate; communicates effectively to the reader; shows understanding of the open-ended problem's mathematical ideas and processes; identifies all the important elements of the problem." The document includes three scored student responses for each problem.

The document also includes a rationale for alternative assessment, and the context for the Mt. Diablo assessment. No technical information is included The author has given educators permission to copy this document for their own use

(TC# 500.3MTDIAC2)

Nicholls, John G., Paul Cobb, Erna Yackel, et al. ***Students' Theories About Mathematics and Their Mathematical Knowledge: Multiple Dimensions of Assessment.*** **Located in: Assessing Higher Order Thinking in Mathematics, Gerald Kulm (Ed.), 1990. Available from: American Association for the Advancement of Science, 1333 H St. NW, Washington, DC 20005, (301) 645-5643.**

This paper reports on a series of studies on student attitudes toward mathematics and their relationship to mathematical knowledge and understanding Dimensions of attitudes toward math were

1. How motivated students are to do math

2. Student beliefs about what causes success in math

3. Student views of the benefits of learning math

All items are included

(TC# 500.3STUTHA)

North Carolina Department of Public Instruction. ***Linking Curriculum, Instruction, and Assessment: The Patterns, Relationships, and Pre-Algebra Strand, Grades 3-8 Mathematics,*** **circa 1993. Available from: North Carolina Department of Public Instruction, 301 N. Wilmington St., Raleigh, NC 27601, (919) 715-1895.**

In 1989, North Carolina adopted the revised Standard Course of Study for Mathematics K-8 In 1991, the state began field testing open-ended and objective test items in grades 3-8 to be used as part of the end-of-grade tests. The new testing program emphasizes higher-order thinking and problem solving. In order to assist teachers to move to a new kind of instruction and assessment, this 60-page document was developed It describes five to seven math objectives for each grade (3-8) and gives two sample test items (one multiple-choice and one open-ended) for each objective Scoring on the open-ended problems uses a three- or four-point general rubric that is very sketchy

No technical information nor samples of student work are included Some instructional ideas for each objective are provided

(TC# 500.3LINCUI)

Office of Educational Research and Improvement (OERI). ***Improving Math and Science Assessment. Report on the Secretary's Third Conference on Mathematics and Science Education*, 1994. Available from: U.S. Government Printing Office, Superintendent of Documents, Mail Stop: SSOP, Washington, DC 20402**

This 15-minute video and companion booklet covers highlights of the *Secretary's Third Conference on Mathematics and Science Education: Improving Math and Science Assessment* during which more than 550 educators, researchers and policymakers gathered to talk about such questions as: Why must assessment change? What forms of math and science assessment can help American students succeed in these subjects? How can districts reforming assessment assure that tests are fair for students of all races and income levels and both genders? How can better assessments fuel the drive toward comprehensive reform of American education and higher academic standards? Recommendations, insights and information from the conference are incorporated into the video and the accompanying report

(TC# 000.6IMPMASv & 000.6IMPMASt)

Oregon Department of Education. ***Oregon Dimensions of Problem Solving*, 1994. Available from: Office of Assessment and Technology, Oregon Department of Education, 255 Capitol St NE, Salem, OR 97310, (503) 378-8004.**

The Oregon Department of Education began giving open-ended math problems to a sample of students in grades 3, 5, 8, and 11 in 1992. The five short, written problems used in each grade in 1992 are included in this document, as are student instructions. Responses are scored on four dimensions, or traits: (1) conceptual understanding of the problem—the ability to interpret the problem and select appropriate information to apply a strategy for solution; (2) procedural knowledge—the ability to demonstrate appropriate use of math; (3) skills to solve the problem; and (4) communication—the ability to use math symbols well and the ability to explain the problem solution.

Each trait is scored on a scale of 1-5. The 1994 scoring guides are included in this document along with one sample student problem. No technical information nor anchor papers are included.

(TC# 500.3ORDIPS)

Oregon New Standards Project. ***Student Portfolio Handbook—Quantify/ Science/ Mathematics—Field Trial Version/Elementary*****, 1994. Available from: Oregon Dept. of Education, Public Service Bldg., 255 Capitol St. NE, Salem, OR 97310, (503) 378-8004. Also available from: New Standards at the National Center on Education and the Economy, 39 State St., Suite 500, Rochester, NY 14614, (716) 546-7620, fax (716) 546-3145.**

This document is the elementary science and mathematics portfolio student handbook developed by the Oregon New Standards Project. It is organized around student content and process goals in Oregon's Certificate of Initial Mastery (CIM)—number sense, estimation, geography, measurement, statistics, patterns, physical, earth, space and life systems skills, science as inquiry, problem solving, interpreting results, connections, and communication.

The document includes a description of these areas, examples of items that could be selected for the portfolio that demonstrate student ability in these areas, entry cover sheets, and a self-review checklist. Students are responsible for assembling their own portfolios. The document also includes draft scoring guides and a letter of introduction. No technical information or sample student work is included.

(TC# 000.3STUPOQ)

Pandey, Tej. ***Power Items and the Alignment of Curriculum and Assessment.*** **Located in: Assessing Higher Order Thinking in Mathematics, Gerald Kulm (Ed.), 1990. Available from: American Association for the Advancement of Science, 1333 H St. NW, Washington, DC 20005, (301) 645-5643.**

The author presents a philosophy and approach for thinking about the development of a test of mathematics problem solving, and provides some examples of multiple-choice and short-answer "power" questions developed by the California Assessment Program.

The author maintains that typical content-by-process matrices used to specify the content of tests tend to result in tests that measure minuscule pieces of information that are fragmented and non-integrated. The author prefers to have assessment tasks that are broader in focus and cut across several process/content areas, so that in order to get the right answer, students must use skills like organizing information, representing problems, and using strategies.

(TC# 500.6POWITA)

Pandey, Tej. ***A Sampler of Mathematics Assessment*****, 1991. Available from: California Department of Education, Bureau of Publications, Sales Unit, PO Box 944272, Sacramento, CA 94244, (916) 445-1260.**

This sampler describes the types of assessment that the California Assessment Program (CAP) is proposing to support curricular reforms. Illustrated and discussed are open-ended problems, enhanced multiple-choice questions, investigations, and portfolios. These four types of activities are intended to measure mathematical understandings that students develop over a period of several years

This monograph includes a definition of "mathematical power"—the ultimate goal of mathematics instruction, guidance in the characteristics of assessment tasks that will encourage and measure power, a few sample student responses to problems, and help with implementation of alternative assessment

All performance-based techniques will use a six-point holistic scale. This scale is briefly described The scale will be tailored for individual tasks

(TC# 500.3SAMMAA)

Paulson, Leon. ***Portfolio Guidelines in Primary Math*, 1992. Available from: Multnomah County Educational Service District, PO Box 301039, Portland, OR 97220, (503) 255-1842.**

This monograph provides some assistance with getting started with portfolios in the primary grades. The author believes that the most important purpose for mathematics portfolios is to prompt students to take control of their own learning. Therefore, the student should be in control of the portfolio. (The author, however, also points out that there might be other audiences and purposes for the portfolios that might have to be addressed.)

The author provides some ideas for tasks that students could do to generate material for the portfolio, provides some very practical suggestions for getting started, gives ideas for activities to encourage student self-reflection, and shows some draft holistic criteria for evaluating portfolios.

An example of the user-friendly way this monograph provides practical help is: "Remember, the portfolio is telling a story. Each item in a portfolio is there for a reason. It should not require a mind reader to figure out why it is there. A portfolio entry includes a piece of work plus information that makes its significance clear—the reason it was selected, the learning goals illustrated, student self-reflections, and (always!) the date."

Note: A new version is due out in the fall of 1994.

(TC# 500.6PORGUP)

Paulson, Leon, and Pearl Paulson. ***An Afternoon to Remember: A Portfolio Open House for Emotionally Disabled Students*, 1992. Available from: Multnomah County Educational Service District, PO Box 301039, Portland, OR 97220, (503) 255-1842.**

Reynolds School District adapted Crow Island's "portfolio night" for use with severely emotionally disabled students. This paper describes how the afternoon was set up, what happened, student debriefing sessions, and changes in format based on student comments.

(TC# 000.6AFTREP)

Perlman, Carole. ***The CPS Performance Assessment Idea Book*****, November 1994. Available from: Chicago Public Schools, 1819 W. Pershing Rd., Chicago, IL 60609.**

This handbook was developed to assist educators to develop performance assessments. Its most notable feature is a bank of over 90 sets of rubrics for assessing student performance in various grade levels and subject areas—reading, writing, mathematics, science, social studies, and fine arts. There are also well written sections on how to develop (and evaluate the quality of) rubrics and performance tasks.

(TC# 000.3CPSPEA)

Pfeiffer, Sherron. ***NIM Game Project*****, 1994. Available from: Southeast EQUALS, 14 Thornapple Dr., Hendersonville, NC 28739, (704) 692-4078.**

The assessments described in this document are appropriate for upper elementary and middle school students. Two project tasks are included, one individual and one group. The projects require students to create a game that requires application of math skills. These extended projects are used after students have had many opportunities to work with different kinds of NIM games. Projects become part of a portfolio that shows growth over time.

The projects are scored using criteria specific to these tasks. The criteria revolve around the quality of the game and its usefulness in teaching the math skills specified. The project instructions and scoring guide are included. Also included is a manual with (a) lots of help on how to use NIM games with students, (b) 10 HIM games developed by others, and (c) a general discussion of the characteristics of worthwhile instructional tasks. No sample student work nor technical information is included.

(TC# 500.3NIMGAP2)

Porter, Andrew C. ***Standard Setting and the Reform of High School Mathematics and Science*****, 1995. Available from: Wisconsin Center for Education Research, School of Education, University of Wisconsin-Madison, 1025 W. Johnson St., Madison, WI 53706, (608) 263-4200.**

The author reports on a study that looks at the effects of increased enrollment in academic classes resulting from raising course-taking graduation requirements. Previous studies discovered that increased graduation requirements did not raise dropout rates and that, indeed, students were taking more academic classes, especially science and math. This study examined whether the affected academic courses were "watered down" to accommodate weaker and less motivated students. The author found that courses were not watered down. The conclusion is that standards for high school students have, indeed, been raised.

(TC# 000.6STASER)

Pritchard, Diane. ***Student Portfolios—Are They Worth the Trouble?*****, 1992. Available from: Sisters Middle School, PO Box 555, Sisters, OR 97759, (503) 549-8521.**

This paper was written by a middle school math and English teacher. It provides practical help with how to set up a portfolio system in math by describing her purpose for having a portfolio, the types of activities included, and activities to get students to self-reflect (including an idea for tests).

(TC# 500.3STUPOT)

Psychological Corporation, The. ***Alternative Model Assessment Package (AMAP)—Mathematics*****, 1993. Available from: The Psychological Corporation, Order Service Center, PO Box 839954, San Antonio, TX 78283, (800) 228-0752, fax (512) 270-0327.**

The AMAP package consists of mathematics and language arts performance tasks for students in grades 3-10. The math tasks consist of a series of questions on a common theme. For example, in the level 5 task, students use ratios to determine dimensions for flags. Each task takes two 1-hour class periods. Students work individually. Student responses to the investigation are scored as a whole—the various parts and steps do not receive separate scores. A six-point holistic rubric is used—only one score is given. The rubric emphasizes completeness, communication, relevance, logic, and computation.

This document includes one sample task plus administration instructions and a scoring guide. No sample student work nor technical information is included.

(TC# 500.3AMAP-M)

Psychological Corporation, The. ***GOALS: A Performance-Based Measure of Achievement*****, 1992. Available from: The Psychological Corporation, Order Service Center, PO Box 839954, San Antonio, TX 78283, (800) 228-0752.**

GOALS is a series of open-response questions that can be used alone or in conjunction with the MAT-7 or SAT-8, or any achievement test. Three forms are available for 11 levels of the test covering grades 1-12 in the subject areas of science, math, social studies, language and reading. Each test (except language) has ten items. The manual states that the math questions assess student problem solving, communication, reasoning, connections to other subjects, estimation, numeration, geometry, patterns, statistics, probability and algebra. Tasks are multiple, short problems. The manual draws the distinction between the approach taken in

GOALS (efficiency in large-scale assessment), and the related publication "Integrated Assessment System" which has fewer tasks pursued in more depth.

Responses are scored on a scale of 0-3, where 0 is "response is incorrect" and 3 is "accurate and complete with supporting information." The scoring guide is generalized and is used for all problems. Scoring can be done locally or by the publisher. There is good assistance with scoring philosophy and procedures. There are two sample student performances for each score point for each question.

The holistic scales are combined in various ways to provide indicators of overall conceptual understanding and various specific aspects of problem solving and using procedures. These are, however, not scored directly. Rather, it is analogous to multiple-choice tests in which the correct items are combined in various ways to give subtest scores.

Both norm-referenced (percentiles) and criterion-referenced (how students perform on specific concepts) score reports are available. A full line of report types (individual, summary, etc.) are available.

The materials we obtained did not furnish any technical information about the test itself.

(TC# 510.3GOALS)

Psychological Corporation, The. *Integrated Assessment System: Mathematical Performance Assessment*, 1991. Available from: The Psychological Corporation, Order Service Center, PO Box 839954, San Antonio, TX 78283, (800) 228-0752.

This is a series of 14 tasks designed to be used with students in grades 2-8. Two task booklets were designed for each grade level, but can also be used in spring testing of the grade below or fall testing of the grade above. Each task booklet presents a problem situation that is expanded on and applied to a series of questions. For example, various task booklets focus on symmetry, breaking a tie in an election, planning an orchard to maximize yield, and bar codes. Questions involve such things as figuring out an answer and explaining how the solution was reached, and generating a principle and applying it to a new situation.

Solutions are scored either holistically (0-6) or analytically (four, 4-point scales). The performance criteria represent generalized features of problem solving and so can be used to score performance on any task. The holistic scale is used to provide an overall picture of performance; raters look for quality of work, evidence of understanding of concepts, logical reasoning, and correct computations. The analytical traits are: reasoning, conceptual knowledge, communication, and procedures. Scoring can be done either locally or by the publisher.

The set of materials we obtained includes a brief description of the scoring rubrics and one example of a scored student test. Technical information was not included.

(TC# 500.3INTASM)

ERIC

Qin, Zhining. ***Minnesota Mathematics State Assessment*, 1992-93. Available from: Office of Teaching and Learning, Minnesota Department of Education, Capitol Square, 550 Cedar St., St. Paul, MN 55101, (612) 296-6104, fax (612) 296-3348.**

The Minnesota Mathematics State Assessment has both open-ended and multiple-choice questions for grades 5, 8, and 11 designed to assess skills such as: problem solving, communication in math, applying math to real-life problems, explaining thinking, and estimation. The purpose of the assessment is to provide information to make a judgment about the effectiveness of the mathematics program at both the local and state level.

This document contains sample open-ended materials from the 1992 and 1993 assessments. At each grade level students are asked a series of questions which require them to solve a problem, draw a picture, explain their thinking, write a problem, etc. Scoring is task specific. Sample student work is included.

Substantial technical studies have been conducted including validity, rater agreement, and inferential and descriptive statistics. Materials are publicly available at cost.

(TC# 500.3MNMATG)

Regional Educational Laboratory Network Program. ***Improving Science and Mathematics Education—A Database and Catalog of Alternative Assessments*, 1994. Available from: Document Reproduction, Northwest Regional Educational Laboratory, 101 SW Main St., Suite 500, Portland, OR 97204, (503) 275-9519, fax (503) 275-9489.**

The intent of this database/catalog is to provide information to those who want to learn more about current efforts to redesign assessment to match changing goals for students and ideas about instruction. The database contains descriptive information on alternative assessments in science and mathematics that cover all grade levels, levels of assessment (classroom to international), and purposes. Developers include teachers, school districts, state departments of education, national governments, universities, and other research and development institutions. The most appropriate users are assessment specialists, curriculum coordinators, and others responsible for developing alternative assessments.

Note that the database contains only information *about* the assessments. Actual copies of the assessment instruments themselves are available from the contact people listed in the catalog. The database operates using FileMaker Pro software from Claris.

(TC# 000.1DATCAA2)

Regional Educational Laboratory Network Program. ***Improving Science and Mathematics Education—A Toolkit for Professional Developers: Alternative Assessment*, 1994. Available from: Document Reproduction, Northwest Regional Educational Laboratory, 101 SW Main St., Suite 500, Portland, OR 97204, (503) 275-9519, fax (503) 275-9489.**

The 552-page Toolkit was designed cooperatively by all 10 regional labs as a teacher professional development resource. It is a compilation of activities and supportive materials that serve both as an alternative assessment resource and a means of engaging teachers in dialogue about changing the way mathematics and science have traditionally been taught and assessed. The Toolkit contains:

- Information and professional development activities on the topics of: rationale for alternative assessment, integrating assessment and instruction, design options for alternative assessment, being a critical consumer of assessments, grading/reporting, and planning effective professional development

- Twenty-one sample assessments

- Bibliography of resources

(TC# 000.6TOOKIP2)

Riverside Publishing Company, The. ***Arizona Student Assessment Plan—Mathematics.*** **Available from: The Riverside Publishing Co., 8420 Bryn Mawr Ave., Chicago, IL 60631, (800) 323-9540.**

Arizona is developing open-response, on-demand assessments in math, reading, writing, social studies, and science for grades 3, 8, and 12. The math test has been used for about two years; the science test is still under development. The mathematics test requires no manipulatives or equipment. Students provide short answers to a series of questions surrounding a common theme, such as a rock climbing competition or a "pizza spinner." They also sometimes provide explanations for responses or show computations.

Scoring is task-specific. Points are assigned for the correctness of the response or the number of responses given.

The tests were developed by Riverside and are under copyright restriction until at least 1996. Permission to use any part of the assessment must be granted both by Riverside and the Arizona Department of Education.

(TC# 500.3ARISTM) — IN-HOUSE ONLY

ERIC

Riverside Publishing Company, The. ***California Program for Learning Assessment—Mathematics Performance Assessments*, 1994. Available from: The Riverside Publishing Company, 8420 Bryn Mawr Ave., Chicago, IL 60631, (800) 323-9540.**

The *California Program for Learning Assessment* addresses language arts and mathematics in eight levels for grades 3-10 The math tests are designed to be given in 45 minutes and have two parts. Part 1 contains two open-ended math problems which take approximately 30 minutes to complete. Part 2 has seven multiple-step, multiple-choice problems which take approximately 15 minutes to complete The test is designed to assess problem solving, application of knowledge, and communication skills rather than knowledge of specific facts or operations. The open-ended problems require written responses and are completed individually. Both open-ended and multiple-choice questions are thought-provoking.

Open-ended responses are scored using a 0-4 point, generalized, holistic rubric where "4" "Shows a complete understanding of the problem and addresses all relevant mathematical ideas. Exhibits sound reasoning and draws logical conclusions. Communicates clearly through the use of appropriate charts, graphs, diagrams, illustrations, and/or words. Provides computation (where required) adequate for the solution of the problem." Although somewhat sketchy, this rubric attempts to address the "big" outcomes in the NCTM standards. To help the scorer, the general rubric is tailored to each particular problem.

The materials we received mention a pilot test in 17 California schools, but no details are given.

(TC# 500.3CALPRL) IN-HOUSE USE ONLY

Riverside Publishing Company, The. ***Performance assessments for ITBS, TAP and ITED [various levels and subject areas]*, 1993. Available from: The Riverside Publishing Company, 8420 Bryn Mawr Ave., Chicago, IL 60631, (800) 323-9540.**

Riverside is publishing a series of open-response items in the areas of social studies, science, mathematics, and language arts. Nine levels are available for grades 1-12. They supplement achievement test batteries available from the publisher: ITBS, TAP, and ITED. Each level uses a scenario to generate a series of related questions, some of which have only one right answer, and others of which are more open-ended and generative. Tests take $1^1/_2$ to 2 hours depending on grade level.

No information about scoring, no sample student performances, and no technical information were included in the materials we received. However, the publisher's catalog indicates that scoring materials are available and that the tests are normed.

(TC# 060.3PERAST) IN-HOUSE USE ONLY

Romberg, Thomas A. ***Assessing Mathematics Competence and Achievement*, 1989. Available from: National Center for Research in Mathematical Sciences Education, Wisconsin Center for Educational Research, University of Wisconsin, School of Education, 1025 W. Johnson St., Madison, WI 53706, (608) 263-4200.**

This paper describes the author's view of what it means to be literate mathematically. It then describes the instructional and assessment implications of this goal. The author believes that we need to assess not only mathematical knowledge but also the structure of the knowledge.

(TC# 500.5ASSMAC)

Romberg, Thomas A. ***The Domain Knowledge Strategy for Mathematical Assessment*, 1987. Available from: National Center for Research in Mathematical Sciences Education, Wisconsin Center for Educational Research, School of Education, 1025 W. Johnson St., Madison, WI 53706, (608) 263-4200.**

This document provides a brief overview of the "Domain Knowledge" strategy used by the National Center for Research in Mathematical Sciences Education to assess math knowledge of students. This approach is contrasted to the typically used "Content by Behavior Matrix" approach in which content topics are crossed with behavior (usually some form of Bloom's taxonomy). The author maintains that this approach is outdated; the behavior dimension fails to reflect contemporary notions of how information is processed and the content dimension is an inadequate way to describe what is meant by "knowing mathematics."

The "Domain Knowledge" approach involves making a "map" or network of a concept domain. This reflects a more integrated and coherent picture about knowledge. These maps can be used to generate tasks, assessment criteria, and formats that get at both "correctness" of responses and the strategies used to arrive at the answer.

(TC# 500.6DOMKNS)

Romberg, Thomas A. ***Evaluation: A Coat of Many Colors*, 1988. Available from: National Center for Research in Mathematical Sciences Education, Wisconsin Center for Educational Research, University of Wisconsin, School of Education, 1025 W. Johnson St., Madison, WI 53706, (608) 263-4200. Also located in: <u>Mathematics Assessment and Evaluation: Imperatives for Mathematics Educators</u>, Thomas A. Romberg (Ed.), 1992. Available from: State University of New York Press, State University Plaza, Albany, NY 12246.**

This paper describes the impact of assessment information on decision making and describes the ways in which assessment must change if it is to have a positive impact on such decisions.

(TC# 500.6EVACOM)

Romberg, Thomas A. ***Mathematics Assessment and Evaluation: Imperatives for Mathematics Educators*, 1992. Available from: State University of New York Press, State University Plaza, Albany, NY 12246.**

This book covers several interesting topics with respect to assessment in math Specifically

1. How tests communicate what is valued
2. How current tests will not promote the recommendations in the NCTM standards
3. Various considerations when developing tests: calculators, how to adequately model knowledgeable students, etc
4. Setting up assessment that is intended to influence instruction

Although authoritative, this book is written in a very academic style, which makes it less accessible to general readers. Articles that are most relevant to this bibliography are entered separately.

(TC# 500.6MATASE)

Romberg, Thomas A., and Linda D. Wilson. ***Alignment of Tests with the Standards.*** **Located in: Arithmetic Teacher, September 1992, pp. 18-22.**

The authors make the argument that teachers teach to tests. Therefore, if we want the NCTM standards to be implemented we need to have tests that reflect the standards. The authors feel that many current norm-referenced tests do not match the standards. Finally, they present tasks from several innovative assessments that they feel do reflect the standards.

(TC# 500.6ALITEW)

Romberg, Thomas A., Linda D. Wilson, 'Mamphono Khaketla, et al. ***Curriculum and Test Alignment.*** **Located in: Mathematics Assessment and Evaluation: Imperatives for Mathematics Educators, Thomas A. Romberg (Ed.), 1992. Available from: State University of New York Press, State University Plaza, Albany, NY 12246.**

This article reports on two studies on the alignment of current standardized tests and alternative assessments to the NCTM standards. Results showed that current standardized tests are weak in five of six content and process areas, and place too much emphasis on procedures and not enough on concepts. The authors present several examples of test questions that they feel do match the standards.

(TC# 500.6CURTEA)

Romberg, Thomas A., E. Anne Zarinnia, and Steven R. Williams. ***The Influence of Mandated Testing on Mathematics Instruction: Grade 8 Teachers' Perceptions*, 1989. Available from: National Center for Research in Mathematical Sciences Education, Wisconsin Center for Educational Research, School of Education, 1025 W. Johnson St., Madison, WI 53706, (608) 263-4200.**

This monograph reports on the first of a sequence of studies on mandated testing in mathematics. This study was a large-scale questionnaire survey to find out from Grade 8 teachers how influential mandated testing was on their teaching of mathematics. The results of the study showed that nearly 70 percent of the teachers reported that their students take a mandated test. Secondly, because teachers know the form and character of the tests their students take, most teachers make changes in their teaching to reflect this knowledge. Third, the kinds of changes teachers make are in contrast to the recommendations made by the NCTM standards. Specific examples are given.

Although this paper does not describe an alternative assessment device, it does provide reasons for seeking alternative ways of assessing math.

(TC# 500.6INFMAT)

Schoenfeld, Alan H. ***Teaching Mathematical Thinking and Problem Solving.*** **Located in: <u>Toward the Thinking Curriculum: Current Cognitive Research</u>, Loren B. Resnick & Leopold E. Klopfer (Eds.), 1989. Available from: Association for Supervision and Curriculum Development, 1250 N. Pitt St., Alexandria, VA 22314-1403, (703) 549-9110.**

Although this article is more about defining what mathematical problem solving is than about assessment, it presents an interesting visual way to represent how students spend their time when solving a problem. It also compares a plot of time use for a good problem solver to a plot for an inefficient problem solver.

Essentially, the plotting procedure involves tracking the sequence in which people use different steps in the problem-solving process (reading the problem, analyzing the problem, exploring a solution strategy, planning, implementing a strategy, and verifying the results) and the amount of time spent on each. Good problem solvers spend a lot of time analyzing and planning, with many self-checks on "how it is going." Poor problem solvers tend to fixate on a possible line of attack and pursue it relentlessly even when it is clearly not going well. Additionally, there are very few stops to self-check on how it is going.

(TC# 500.5STOWTET)

Scottish Examination Board. ***Standard Grade - Revised Arrangements in Mathematics,*** **1987. Available from: Mr. K. Hutchon, Examination Officer, Ironmills Rd., Dalkeith, Midlothian, Edinburgh, Scotland, EH22 1LE, UK (031) 663-6601.**

The Scottish Examination Board prepares end-of-course tests for a variety of high school subjects to certify level of student competence. The course syllabus for mathematics calls for coverage of number, money, measurement, geometry, trigonometry, algebra, and graphs/tables. The goals of the course are: knowledge/understanding, reasoning/applications, and investigating. There are two main parts of the assessment in math—written tests (developed by the Examination Board) and performance assessments (conducted by teachers according to specifications developed by the Examination Board). The two parts are combined to rate student competence on a scale of 1-7 (1 being high), both overall and for each goal.

On-demand written tests, developed each year, cover knowledge/understanding and reasoning/applications. Three levels of the test are available: Foundation, General and Credit. Depending on the percent correct score, students can obtain ratings of 1 or 2 on the Credit level, 3 or 4 on the General level, and 5 or 6 on the Foundation level. All questions are short answer or multiple-choice and are scored for degree of correctness of the answer.

The hands-on performance assessments must cover a range of activities including: the identification and use of real data; the use of measuring or drawing instruments; the recognition or exploration of a pattern, conjecture, or proof; and the formulation of a mathematical model. Candidates write up their investigations in the form of a report. Performances are scored on "understanding and organizing the task," "carrying out the task," and "communication." A total of 12 marks (points) is available. General criteria for level designation are provided as well as the point conversions described above.

The package of materials we received included the course syllabus, specifications for the written and performance assessments, and copies of the written tests for 1993. It did not include technical information nor sample student responses.

(TC# 500.3MATSTG)

Secada, Walter G., Sherian Foster, and Lisa Byrd Adajian. ***Intellectual Content of Reformed Classrooms.*** **Located in: NCRMSE Research Review 4, Winter 1995, pp. 3-8. Available from: National Center for Research in Mathematical Sciences Education, Wisconsin Center for Education Research, University of Wisconsin, 1025 W. Johnson St., Madison, WI 53706, (608) 263-7582, fax (608) 263-3406.**

As part of a study on reform in mathematics education, the authors are developing a classroom observation form containing indicators of the classroom's "intellectual substance." There are 10 scales intended to describe a lesson's content in terms of teacher and student behavior, student engagement, and the shared norms of the class revealed through the interaction patterns of the class. The 10 scales are:

ERIC

- Mathematical Concepts—the content of the lesson

- Use of Mathematical Analysis—student engagement in analytical math beyond rote uses of algorithms, e.g., searching for math patterns, making math conjectures, or justifying conjectures

- Depth of Knowledge and Student Understanding—the depth of student knowledge being developed in a lesson

- Mathematical Connections

- Cross-Disciplinary Connections—

- Value Beyond the Class

- Mathematical Discourse and Communication—the degree to which talking is used to understand math

- Locus of Mathematical Authority—the extent to which authority is shared with students

- Social Support for Student Achievement—conveying high expectations

- Student Engagement in Doing Mathematics—student motivation

The article includes a description of the scales and a sample classroom example but no detail on scoring and no technical information.

(TC# 500.4INTCOR)

Semple, Brian. ***Assessment of Achievement Programme—Mathematics: Second Survey 1988.*** **Available from: Brian Semple, Principal Research Officer, New St. Andrews House, Room 4/51a, Edinburgh, Scotland EH1 3SY, UK (031) 244-4388.**

The "Assessment of Achievement Programme (AAP)" was established by the Scottish Office Education Department in 1981 to monitor the performance of pupils in grades 4, 7, and 9. The 1989 report "Mathematics: Second Survey 1988" reports on the 1988 mathematics assessment. The assessment covered geometry, algebra, estimation, and statistics (depending on grade level).

Assessment tasks used two formats: written and practical. However, the report we have does not describe these two formats, nor explain how responses were scored. Schools in the assessment sample were also invited to comment on their mathematics program.

The document we have includes the rationale for the assessment and description of student performance. No technical information is included.

(TC# 500.3ASSACP)

Semple, Brian McLean. ***Performance Assessment: An International Experiment,*** **1991. Available from: Educational Testing Service, The Scottish Office, Education Department, Rosedale Rd., Princeton, NJ 08541, (609) 734-5686.**

Eight math and eight science tasks were given to a sample of thirteen-year-olds in five volunteer countries (Canada, England, Scotland, USSR, and Taiwan). This sample was drawn from the larger group involved in the main assessment. The purpose of the assessment was to provide an information base to participating countries to use as they saw fit, and to examine the use of performance assessments in the context of international studies.

The 16 hands-on tasks are arranged in two 8-station circuits. Students spend about five minutes at each station performing a short task. Most tasks are "atomistic" in nature; they measure one small skill. For example, the 8 math tasks concentrate on measuring length, angles, and area, laying out a template on a piece of paper to maximize the number of shapes obtained, producing given figures from triangular cut-outs, etc. Some tasks require students to provide an explanation of what they did. All 16 tasks are included in this document, although some instructions are abbreviated and some diagrams are reduced in size. the complete tasks, administration and scoring guides are available from ETS.

Most scoring is right/wrong; student explanations are summarized by descriptive categories. There is also observation of the products of students' work.

Student summary statistics on each task are included. There is a brief summary of teacher reactions, student reactions, the relationship between student performance on various tasks, and the relationship between performance on the multiple-choice and performance portions of the test. A few sample student performances are included.

(For related information, see Nancy Mead, also listed in this bibliography.)

(TC# 600.3PERASS)

Serrano, Claudia. ***A Look at Portfolio Assessment in San Diego High School's Sophomore House,*** **1991. Available from: San Diego City Schools, 4100 Normal St., Room 3133, San Diego, CA 92103, (619) 298-8120.**

This paper describes an interdisciplinary (physics, math, and English) portfolio system for tenth graders that supports block scheduling in an inner city magnet school. Students keep a notebook of all work in each class. Class portfolios are developed from selected work in the notebook. Class portfolios are used as the basis for the culminating "House Portfolio" in which students select work to demonstrate that they have attained specified learning goals. The "House Portfolio" also includes written reflection and a final exhibition of mastery.

The document includes student instructions for assembling the portfolio, an entire student portfolio, instructions for a formative oral presentation of their portfolio, checklists and evaluation forms, and assistance with reflective writings and exit exhibitions. No technical information is included.

(TC# 000.3LOOPOA)

Shoecraft, Paul. *MOVE IT Math Concepts 1*, 1988-1992. Available from: Mathematics Education Initiative, University of Houston-Victoria, 2506 E. Red River, Victoria, TX 77901, (512) 576-3151.

The *MOVE IT Math Concepts 1* and *MOVE IT Math Levels of Use Questionnaire* together form a two-pronged assessment strategy to promote the implementation of Level 1 of the *MOVE IT* math program. *MOVE IT* math is a K-6, university-supported professional development program that advocates mathematics instruction based on the use of manipulatives to address a wide variety of learning styles (e.g., visual, auditory, kinesthetic). It consists of three half-hour inservices (Level 1 is one of the three).

The *Math Concepts 1* assessment instrument is a constructed response, paper-and-pencil test of the concepts of (1) equals as balanced, (2) exchanging "up" in base ten (3) being an exchanging expert, and (4) exchanging "down" in base ten. A measurement item involving adding feet and inches is included to assess ability to take into account the context in which numbers appear.

Copies of the Concepts 1 test, answers, and test results from six years of use are available. They may be used as it or modified, with appropriate citation to the authors.

(TC# 500.3MOVITM)

Silver, Edward A., and Jeremy Kilpatrick. *Testing Mathematical Problem Solving*. Located in: <u>The Teaching and Assessing of Mathematical Problem Solving</u>, Randall Charles and Edward Silver (Eds.), 1988. Available from: National Council of Teachers of Mathematics, Inc., 1906 Association Dr., Reston, VA 22091.

This paper discusses two topics: how assessment can inform instructional decision making and how it communicates what we value. The authors propose that the National Assessment of Educational Progress and many other math tests do not provide the type of information needed for the improvement of mathematics instruction. The information useful for improvement of instruction would be types of errors kids make, how automatic mathematical processes are, and the cognitive structures and abilities associated with expertise in the domain being tested.

(TC# 500.6TESMAP)

Stecher, Brian M. ***Describing Secondary Curriculum in Mathematics and Science: Current Status and Future Indicators*****, 1992. Available from: RAND, 1700 Main St., PO Box 2138, Santa Monica, CA 90407.**

The author describes what could go into an indicator system of the health of science and mathematics education. He concludes that current data sources for these indicators are inadequate.

(TC# 000.6DESSEC)

Stenmark, Jean Kerr. ***Mathematics Assessment: Myths, Models, Good Questions, and Practical Suggestions*****, 1991. Available from: National Council of Teachers of Mathematics, 1906 Association Dr., Reston, VA 22091.**

This monograph was designed for teachers in the elementary grades. It is a collection of examples of assessment techniques that focus on student thinking. Topics include the rationale for new ways of assessing mathematics, the necessity of integrating assessment and instruction, designing performance assessments (most emphasis is on designing the task, although sample holistic and analytical trait scoring systems are shown), what to look for during classroom observations and interactions (including questions to ask to get at various types of thinking), portfolios (including types of items to include and the types of information they can demonstrate about students, and criteria for evaluation), student self-assessment, and hints to make assessment work in the classroom. No technical information is provided.

(TC# 500.3MATASM)

Stuart Foundations Project Teachers. ***Language Arts and Science Performance Assessment Sampler, 1993.*** **Available from: San Diego City Schools, 4100 Normal St., Room 3133, San Diego, CA 92103, (619) 298-8120.**

This document includes 12 performance assessment project tasks developed by teachers for students in grades K-3 and 4-8. Some of the tasks are interdisciplinary (science, math, writing,) and some are subject specific (mostly writing). The tasks themselves are interesting and may provide ideas for others developing performance assessments. This document does not include rationale or context for the tasks, technical information, or sample student work. The performance criteria listed for each project are sketchy.

(TC# 100.3LANARS)

Surber, John R. ***Mapping as a Testing and Diagnostic Device*, 1984. Located in: Spatial Learning Strategies—Techniques, Applications, and Related Issues, C. D. Holley & D. F. Dansereau (Eds.). Available from: Academic Press, 1250 6th Ave., San Diego, CA 92101.**

The book is a general discussion of the advantages of, and procedures for, integrating the production of cognitive networks into instruction. The premise is that knowledge of facts, rules, algorithms, etc. is only part of what students need to know. They also need to know how these facts fit together to form a body of knowledge. Without knowledge of the interrelationships, students are not likely to remember the facts or be able to use them correctly when they are remembered.

The Surber paper discusses a particular type of cognitive networking scheme—mapping—and its use in assessment of knowledge structures. The basic procedure consists of taking a completed map for the topic to be tested, and deleting portions in various ways. Students then complete the map given various types of cues.

(TC# 000.6MAPASA)

Surber, John R., Philip L. Smith, Frederika Harper. ***MAP Tests*, 1981 - undated. Available from: John R. Surber, University of Wisconsin-Milwaukee, Department of Educational Psychology, Milwaukee, WI 53201, (414) 229-1122.**

Our review is based on four reports from the author: *Testing for Misunderstanding* (John R. Surber and Philip L. Smith, Educational Psychologist, 1981, 16, 3, pp. 165-174; *Technical Report No. 1, Structural Maps of Text as a Learning Assessment Technique: Progress Report for Phase I;* Surber, Smith, and Frederika Harper, undated, University of Wisconsin-Milwaukee; *Technical Report No. 6, The Relationship Between Map Tests and Multiple Choice Tests,* Surber, Smith and Harper, 1982, University of Wisconsin-Milwaukee; and *Mapping as a Testing and Diagnostic Device,* Surber: Spatial Learning Strategies, 1984, Academic Press, Inc., pp. 213-233 (also available as TC# 000.6MAPASA).

These reports and papers describe the development of map tests as an assessment technique to identify conceptual misunderstandings that occur when students learn from text. The purpose is to diagnose student understanding in order to plan instruction. In this testing technique, the test developer graphically represents concepts and their interrelationships in a map. Then, information from the map is systematically removed. Students complete the map shells. Four different levels of deletion associated with different types of content clues are described. Maps are scored by comparing the student-completed version to the original. Scoring involves looking both at the content included or omitted from the map and the proper relationship between this content. Report #6 describes scoring in more detail.

The authors did a series of studies on this technique, reported on in "Mapping as a Testing and Diagnostic Device." They found good interrater reliability and good consistency between developers of "master maps." They report on comparisons to multiple-choice tests.

Text maps and tests can be constructed in any content area at any grade level. The specific examples in these materials come from chemistry (matter), study skills, and sociology (the development of early warfare).

A manual, designed to teach students how to construct concept maps, is included in Report #1 The authors have given educators permission to copy these documents for their own use

(TC# 150.6MAPTES)

Thompson, Linda. ***Portfolio Model,*** **1994-95. Available from: Linda Thompson, Chief Moses Junior High School, 2215 Westshore Dr., Moses Lake, WA 98837, (509) 766-2661.**

The author is experimenting with the use of portfolios in her seventh grade math classes. Students are asked to included in their portfolio at least one entry for each of: mathematics as problem solving, mathematics as communication, mathematics as reasoning, mathematics connections, estimation, number sense and numeration, concepts of whole number operations, whole number computation, geometry and spatial sense, measurement, statistics/probability, fractions and decimals, patterns and functions. A single entry might serve to illustrate more than one skill. Thus, the portfolio is designed to align with the NCTM standards.

The packet of materials includes the direction sheets for students, a sheet for each portfolio entry (revised in 1995 because students needed additional help selecting entries and reflecting on them), a self/peer rating sheet for group cooperation, a list of required content for a parent conference portfolio, the student version of a scoring guide for individual portfolio entries, and two activities designed to assist students to better understand and use the criteria (added in 1995). The scoring guide is holistic and uses a four-point scale where "4" is: "This response provides proof that you really understand the mathematical concepts you are demonstrating. You have communicated your understanding so well there is no question that you have mastered the ideas being explored." Thus, students are scored on conceptual understanding and communication; the packet contains no rubrics for problem solving, reasoning or connections.

The packet also does not include technical information nor sample student work. The author has given permission for educators to copy the materials for their own use.

(TC# 500.3PORMOD)

Tittle, Carol Kehr and Deborah Hecht. ***Mathematics Assessment Questionnaire: A Survey of Thoughts and Feelings for Students in Grades 7-9—Technical Report*** **and** ***Manual for Users*****, 1990. Available from: Graduate School and University Center, City University of New York, 33 W. 42nd St., New York, NY 10036, (212) 642-2262.**

The purpose of the *Mathematics Assessment Questionnaire* is to survey student thoughts and feelings about learning mathematics in classroom activity settings and to provide information that complements assessments of mathematical understandings. The questionnaire has 143 statements asking students about their awareness of self-regulatory thinking and skills, affective beliefs (interest, value, confidence, anxiety), and motivational and attributional beliefs. These are assessed in the context of three instructional activity settings: during class, working with other students, and homework.

The *Questionnaire* is available as part of a computer-based, classroom assessment package. The package includes student and teacher computer-based forms and a teacher guide. Both the teacher guide and the teacher computer program include instructional suggestions linked to each area of assessment.

(TC# 500.3MATASQ)

Vermont Department of Education. ***Vermont Mathematics Portfolio Project: Grade Eight Benchmarks*****, 1991. Available from: Vermont Department of Education, Vermont Mathematics Portfolio Project, 120 State St., Montpelier, VT 05602, (802) 828-3135.**

This document provides lots of samples of grade eight student work that illustrate different scores for each of the seven analytical traits used in the *Vermont Mathematics Portfolio Project*. Samples were taken from the 1991 portfolio pilot

(TC# 500.3GRAEIB)

Vermont Department of Education. ***Vermont Mathematics Portfolio Project: Grade Four Benchmarks*****, 1991. Available from: Vermont Department of Education, Vermont Mathematics Portfolio Project, 120 State St., Montpelier, VT 05602, (802) 828-3135.**

This documents provides lots of samples of grade four student work that illustrate different scores for each of the seven analytical traits used in the *Vermont Mathematics Portfolio Project*. Samples were taken from the 1991 portfolio pilot.

(TC# 500.3GRAFOB)

Vermont Department of Education. ***Vermont Mathematics Portfolio Project: Resource Book*, 1991. Available from: Vermont Department of Education, Vermont Mathematics Portfolio Project, 120 State St., Montpelier, VT 05602, (802) 828-3135.**

This document includes sample performance tasks taken from portfolio entries submitted by teachers as part of Vermont's 1991 math portfolio pilot project, a resource bibliography, and a list of suggested readings. The purpose is to provide colleagues with tasks that have worked well with students to promote problem solving. *This is meant as a companion document to the Teacher's Guide (TC= 500.3TEAGUI).*

(TC# 500.3RESBOO)

Vermont Department of Education. ***Vermont Mathematics Portfolio Project: Teacher's Guide*, 1991. Available from: Vermont Department of Education, Vermont Mathematics Portfolio Project, 120 State St., Montpelier, VT 05602, (802) 828-3135.**

This document presents Vermont's current view of what should go into a mathematics portfolio, provides detailed information about the scoring criteria for portfolio entries and the portfolio as a whole, discusses how to develop tasks that will invite student problem solving, and provides help with how to manage the portfolios. *This is a companion piece to the Resource Book (TC= 500.6RESBOO).*

(TC# 500.3TEAGUI)

Webb, Noreen. ***Alternative Strategies for Measuring Higher Order Thinking Skills in Mathematics: The Role of Symbol Systems*, 1991. Available from: CRESST, University of California—Los Angeles, 145 Moore Hall, Los Angeles, CA 90024. (213) 825-4711.**

This document presents an overview of a study that is currently taking place at CRESST in which students are asked to represent problems in various equivalent ways (graphs, tables, equations, word problems, and diagrams). The premise is that if a student really understands a problem, he or she should be able to solve the problem presented in any format, and translate from one format to another. Examples are provided of problems represented in different ways.

(TC# 500.6ALTSTF)

Webb, Noreen. ***Collaborative Group Versus Individual Assessment in Mathematics: Processes and Outcomes - CSE Technical Report 352*****, March 1993. Available from: Center for Research on Evaluation, Standards, and Student Testing (CRESST), University of California, Los Angeles, CA 90024, (310) 206-1532.**

The author reports on a study designed to determine the extent to which information from group tasks can be used to make inferences about the abilities of individual students, and also determine what additional information about student skills is provided from group tasks.

The study used 53 seventh grade students who worked in small groups to calculate the costs of long distance phone calls. Two weeks later students worked individually on a similar problem. Work was scored on nine dimensions, e.g., "recognizes that call has multiple minutes," and "applies single cost to each additional minute." The nature of individual student behavior in the group was also analyzed, e.g., students (1) solved the problems correctly aloud with little or no assistance from others, and (2) expressed difficulty with the problems (made errors or asked questions indicating that they were confused).

Results showed that: (1) students working in groups showed uniformly high levels of performance; (2) some lower-achieving students did better when assessed individually than would be predicted from pretest scores, but only in cases when they used the resources of the group to understand the procedures; (3) however, in general, there was a large discrepancy between individual and group performance; (4) analyzing the group process skills of individual students shed considerable light on individual student understanding and on their collaborative skills; (5) students learn more from the group experience if they have been taught how to work productively in teams

(TC# 500.6COLGRV)

Webb, Norman, and Thomas A. Romberg. ***Implications of the NCTM Standards for Mathematics Assessment.*** **Located in Mathematics Assessment and Evaluation: Imperatives for Mathematics Educators, Thomas A. Romberg (Ed.), 1992. Available from: State University of New York Press, State University Plaza, Albany, NY 12246.**

This paper provides a good summary of the NCTM standards, both goals for students and standards for assessment. It uses four of the standards for assessment to develop criteria for assessments:

1. The assessment instrument should provide information that will contribute to decisions for the improvement of instruction.

2. The assessment instruments should be aligned with the instructional goals, the goals for the overall program, and a holistic conceptualization of mathematical knowledge.

3. The assessment instruments should provide information on what a students knows.

4. The results from one assessment instrument should be such that when combined with results from other forms of assessment, a global description is obtained of what mathematics a person or group knows.

The authors then illustrate their points with several assessment tasks that they feel would elicit the correct behavior from students. (These generally have only one correct answer and appear to be scored for degree of correctness.)

(TC# 500.6IMPNCM)

Webb, Norman L. and Arthur F. Coxford, Eds. ***Assessment in the Mathematics Classroom, 1993 Yearbook*****, 1993. Available from: The National Council of Teachers of Mathematics, Inc., 1906 Association Dr., Reston, VA 22091.**

This book contains a number of papers that discuss classroom assessment in grades K-12. Specific topics include student self-assessment, assessing problem solving, EQUALS, NCTM standards, and integrating assessment and instruction.

(TC# 500.6ASSMAC)

Whetton, Chris. ***Key Stage 1, 1993, Teacher's Pack*****, 1993. Available from: HMSO Publications Centre, PO Box 276, London SW8 5DT, England, UK.**

This document contains all administration materials for the 1993 assessment. The assessments consist of a combination of hands-on and paper-and-pencil activities for primary students. English, science and mathematics are covered. In science and math, some activities are scored for the correctness of the answer and some are scored for correctness of approach or explanation. For example, one math task consisted of adding and subtracting using a small number of objects. (The student must get three out of four correct to be scored as "pass.") One science task has students draw pictures or verbally explain what forces are acting on a raft as it floats on the water. (Responses are scored correct if the student conveys the knowledge that there are forces acting down and up on the raft.) Scoring is always tied directly to the task, and tasks usually are designed to cover discrete skills or pieces of knowledge.

All tasks are administered by the classroom teacher in large and small group settings. Results of the 1993 administration are not yet available, so it is unknown how long the most current version takes. (The 1993 assessment was greatly streamlined from the 1992 assessment which took 24 hours, including English.)

(TC# 070.3KEY193)

Wilkins, Cynthia. ***Student Portfolio (Algebra)*, circa 1994. Available from: Northwest Rankin Attendance Center, 62 Terrapin Hill Rd. North, Brandon, MS 39042, (601) 825-2522.**

This algebra or pre-algebra portfolio is intended to represent all that a student has learned during the year The short document describes each entry (e.g., math autobiography, concept explanation, journal topic, specific skills, etc.) and emphasizes student self-reflection. Although point values for each entry are suggested, there are no criteria for assigning points. It has been used for seventh and eighth graders taking algebra. Student directions are available.

(TC# 530.3STUPOA)

Wilson, Linda D. ***A Theoretical Framework Linking Beliefs with Assessment Practices in School Mathematics*, April 1994. Available from: University of Delaware, College of Education, Educational Development, Newark, DE 19716, (302) 831-2573, fax: (302) 831-4110.**

This paper describes a "pure constructivist" notion of teaching, assessment practices that align with pure constructivism, and how consistent the NCTM assessment standards are with a notion of pure constructivism The paper concludes that most current ideas of assessment in math, including the NCTM assessment standards, represent only "soft" constructivism and do not adhere to the strictest tenets of a constructivist notion of how students learn.

(TC# 500.6THEFRL)

Wilson, Mark. ***Measuring Levels of Mathematical Understanding*. Located in: <u>Mathematics Assessment and Evaluation: Imperatives for Mathematics Educators</u>, Thomas A. Romberg (Ed.), 1992. Available from: State University of New York Press, State University Plaza, Albany, NY 12246.**

The premise of this article is that if we want students to be reasoners and thinkers, we need to move from tests that fragment knowledge into "atomistic" pieces, each of which are assessed independently of the others, to assessment procedures that reveal student understanding of the concepts in a domain and their interrelationships. Many current tests are based on lists of skills, each of which is tested separately. "The primary focus of a mathematics testing methodology based on an active, constructive view of learning is on revealing how individual students view and think about key concepts in a subject. Rather than comparing students' responses with a 'correct' answer to a question so that each response can be scored right or wrong, the emphasis is on understanding the variety of responses that students make to a question and inferring from those responses students' levels of conceptual understanding."

The author presents a few examples One is the SOLO taxonomy which looks at degree of formal reasoning. *(See the Collis-Romberg TC# 500.3COLROM on this bibliography.)*

This is a very technical and theoretical article and points up the need to be well grounded in current theory before beginning to develop math assessments.

(TC# 500.6MEALEM)

Zarinnia, E. Anne, and Thomas A. Romberg. ***A Framework for the California Assessment Program to Report Students' Achievement in Mathematics.*** **Located in: Mathematics Assessment and Evaluation: Imperatives for Mathematics Educators, Thomas A. Romberg (Ed.), 1992. Available from: State University of New York Press, State University Plaza, Albany, NY 12246.**

This paper takes the position that assessment affects instruction, and therefore, regardless of the other purposes for the assessment, the instructional implications of our assessments must be taken into account. "If one acknowledges student learning as the central mission of schooling, it further suggests that not only the tasks, but also the system and structures for gathering accountability information and reporting the data, should be designed with instructional needs in mind."

Other points made by this paper are:

1. We need to change the view of math held by many teachers and the general public, that math is a set of rules and formalisms invented by experts that everyone else is to memorize. The authors maintain that both the test itself and the way results are reported will influence these perceptions.

2. Mathematical power means that citizens can use math to solve day-to-day problems. This means we need to seek evidence of students using, reflecting on, and inventing mathematics in the context of value and policy judgments. These experiences should be built into our instruction and assessments.

Implications for turning power over to students are also discussed.

(TC# 500.6FRACAA)

Mathematics Bibliography

Index Codes

A—Type

1 = Example
2 = Theory/how to assess/rationale for alternative assessment
3 = Content/what should be assessed
4 = Related: general assessment; program evaluation, results of studies; technology; attitudes

B—Purpose for the Assessment

1 = Large scale
2 = Classroom
3 = Research

C—Grade Levels

1 = Pre K-K
2 = 1-3
3 = 4-6
4 = 7-9
5 = 10-12
6 = Adult
7 = Special education
8 = All
9 = Other

D—Content Covered

1 = General math
2 = Algebra
3 = Geometry/trigonometry
4 = Statistics/probability
5 = Precalculus/calculus
6 = Other
7 = All/Any

E—Type of Tasks

1 = Enhanced multiple choice
2 = Constructed response, short answers
3 = Long response/essay
4 = On-demand
5 = Project
6 = Portfolio
7 = Group
8 = Other than written
9 = Cognitive map

F—Skills Assessed

1 = Knowledge/conceptual understanding
2 = Application of concepts
3 = Persuasion
4 = Critical thinking/problem solving, reasoning/decision making
5 = Group process skills
6 = Quality of writing/communication
7 = Student self-reflection
8 = Process
9 = Comprehension
10 = Attitudes

G—Type of Scoring

1 = Task specific
2 = General
3 = Holistic
4 = Analytical Trait

DOE=Department of Education or
State Department of Education

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C5Badger (TC#500 3ONTHOM)
C5Bagley (TC# 500 6ASSSTD)
C5CA Assm Prog. (TC#500 3SAMMAA2)
C5CA DOE (TC# 000 6STUSTS)
C5CA DOE (TC#500 3AQUESO)
C5Center for Talent Dev (TC#220 3QUEELM)
C5CT DOE (TC#000 3CONCOC)
C5Ed. Testing Service (TC#500 6NAEPMAR)
C5Finston (TC#500 3STUASU)
C5Ft Hays Ed. Dev. Center (TC# 500 3STAASM)
C5Hall (TC#500 3ALBGRN)

D4AZ Stud. Assm. Prog.(TC# 500 3ARISTM2)
D4Baxter (TC# 500.6MATPEA)
D4CTB McGraw-Hill (TC#500.3CTBMAT)
D4Curriculum Corp. (TC#500 3MATCUP)
D4Doig (TC# 500 3ACTASM)
D4Ed. Testing Service (TC#500 6NAEPMAR)
D4Katims (TC# 500 3PACKET)
D4KY DOE (TC# 060 3KIRIS94)
D4Lawrence (TC#000 6INTUTCV)
D4Lawrence (TC#500 3UTACOC)
D4Models of Auth. Assm. (TC#500 3SUPTEM)
D4Psych. Corp.(TC# 500 3AMAP-M)
D4Psych Corp. (TC#500 3INTASM)
D4Psych Corp. (TC#510 3GOALS)
D4Thompson (TC#500 3PORMOD)

D5Lehman (TC#500 3PERASM)
D5Psych. Corp.(TC# 500 3AMAP-M)

D6Alberta Ed. (TC#500 3DIPEXP)
D6Bagley (TC# 500 6ASSSTD)
D6Curriculum Corp. (TC#500 3MATCUP)
D6Psych. Corp. (TC#500 3INTASM)
D6Tittle (TC# 500 3MATASQ)

D7BC Ministry of Ed. (TC# 000 3BCPERA)
D7CA DOE (TC# 000 6STUSTS)
D7Ft. Hays Ed. Dev. Center (TC# 500 3STAASM)
D7Kulm (TC# 500 6MATASW)
D7Lesh (TC#500 6ASSA[illegible]
D7OR New Stand. Proj. (TC# 000 3STUPOQ)
D7Perlman (TC# 000 3CPSPEA)
D7Pfeiffer (TC#500 3NIMGAP)
D7Pritchard (TC#500 3STUPOT)
D7Reg. Ed. Lab. Net. Prog. (TC# 000 6TOOKIP2)
D7Secada (TC# 500 4INTCOR)
D7Serrano (TC# 000 3LOOPOA)
D7VA DOE (TC#500 3RESBOO)
D7VA DOE (TC#500 3TEAGUI)
D7Webb (TC#500 6ALTSTF)
D7Webb (TC#500 6ASSMAC)

E1CA DOE (TC# 000.6STUSTS)
E1Nat'l Ctr. for Res. on Eval. (TC#150 6ASSWHCU)
E1Pandey (TC#500.3SAMMAA)
E1Riverside Pub. Co. (TC#500 3CALPRL)
E1Whetton (TC#070 3KEY193)

E2Alberta Ed. (TC#500 3DIPEXP)
E2AZ Stud. Assm. Prog.(TC# 500 3ARISTM2)
E2Baxter (TC# 500 6MATPEA)
E2Burton (TC#500 5ADDSEK)
E2CA DOE (TC# 000 6STUSTS)
E2Clark (TC#500 3AIMHIM)
E2CT DOE (TC#000.3CONCOC)
E2CTB McGraw-Hill (TC# 060.3CAT-5a)
E2CTB McGraw-Hill (TC#500 3CTBMAT)
E2Doig (TC# 500 3ACTASM)
E2Ed. Testing Service (TC#500 6NAEPMAR)
E2Kulm (TC# 500 6MATASW)
E2Lane (TC#500 3QUACOA)
E2Larter (TC#100 6BENCHM)
E2Lawrence (TC#000 6INTUTCV)
E2Lawrence (TC#500.3UTACOC)
E2Maclaus (TC# 000 6BRIEXA)
E2MD Assm. Consort. (TC# 000 3MARASC)
E2MD Assm. Consort. (TC# 000 3PERAST)
E2MD DOE (TC# 500 3MSPAPM)
E2Mead (TC#500 3IAEPPA)
E2Meltzer (TC#010 3SUROFP)
E2Models of Auth. Assm. (TC#500 3SUPTEM)
E2Nicoll (TC#500.3MTDIAC2)
E2Pandey (TC#500.3SAMMAA)
E2Psych. Corp.(TC# 500.3AMAP-M)
E2Psych. Corp. (TC#500.3INTASM)
E2Psych. Corp. (TC#510.3GOALS)
E2Qin (TC# 500.3MNMATG)
E2Reg. Ed. Lab. Net. Prog. (TC# 000 6TOOKIP2)
E2Riverside Pub. Co. (TC#060.3PERAST)
E2Riverside Pub. Co. (TC#500 3CALPRL)
E2Semple (TC#600 3PERASS)
E2Shoecraft (TC#500.3MOVITM)
E2Webb (TC#500 6ALTSTF)
E2Whetton (TC#070 3KEY193)

E3Aurora Pub. Schools (TC#000 3SCIMAP)
E3AZ Stud. Assm. Prog.(TC# 500 3ARISTM2)
E3Burns (TC#500 5MATLIT)
E3Burton (TC#500 5ADDSEK)
E3CA Assm. Prog. (TC#500 3SAMMAA2)
E3CA DOE (TC# 000 6STUSTS)
E3CA DOE (TC#500 3AQUESO)
E3CT DOE (TC#000 3CONCOC)
E3CTB McGraw-Hill (TC# 060.3CAT-5a)
E3Ed. Testing Service (TC#500 6NAEPMAR)
E3Ed. Testing Service (TC# 000 3MISALA)
E3Finston (TC#500 3STUASU)
E3Ft. Hays Ed. Dev. Center (TC# 500 3STAASM)
E3Hall (TC#500 3ALBGRN)
E3Hibbard (TC#000.6TOGSTC)
E3Hibbard (TC#500 3SELUSP)
E3Horn (TC#000 3LANCOP)
E3Hynes (TC#500 3K-5MAP)
E3Katims (TC# 500 3PACKET)
E3Kulm (TC# 500 6MATASW)
E3KY DOE (TC# 060 3KIRIS94)
E3Leach (TC#500 3ALTFOE)
E3Lehman (TC#500 3PERASM)

E3Math. Science Ed. Board (TC#500 3MEAUPP)
E3MD Assm. Consort. (TC# 000.3MARASC)
E3MD Assm. Consort. (TC# 000.3PERAST)
E3MD DOE (TC# 500.3MSPAPM)
E3Nat'l Ctr for Res. on Eval. (TC#150 6ASSWHCv)
E3Nicoll (TC#500 3MTDIAC2)
E3OR DOE (TC#500 3ORDIPS)
E3Psych Corp (TC# 500 3AMAP-M)
E3Qin (TC# 500 3MNMATG)
E3Reg. Ed. Lab. Net. Prog. (TC# 000 6TOOKIP2)
E3Riverside Pub. Co. (TC#060 3PERAST)
E3Riverside Pub. Co. (TC#500 3CALPRL)
E3Webb (TC#500 6COLGRV)

E4Alberta Ed. (TC#500 3DIPEXP)
E4Alper (TC# 500 3VARIMP)
E4Aurora Pub. Schools (TC#000 3SCIMAP)
E4AZ Stud. Assm. Prog. (TC# 500 3ARISTM2)
E4Baxter (TC# 500 6MATPEA)
E4Burton (TC#500 5ADDSEK)
E4CA Assm. Prog. (TC#500 3SAMMAA2)
E4CA DOE (TC# 000 6STUSTS)
E4Clark (TC#500 3AIMHIM)
E4CT DOE (TC#000 3CONCOC)
E4CTB McGraw-Hill (TC# 060 3CAT-5a)
E4CTB McGraw-Hill (TC#500 3CTBMAT)
E4Ed. Testing Service (TC#500 6NAEPMAR)
E4Ed. Testing Service (TC# 000 3MISALA)
E4Ft. Hays Ed. Dev. Center (TC# 500 3STAASM)
E4Hall (TC#500 3ALBGRN)
E4Hibbard (TC#000 6TOGSTC)
E4Hynes (TC#500 3K-5MAP)
E4Kulm (TC# 500 6MATASW)
E4Lane (TC#500 3QUACOA)
E4Lawrence (TC#000 6INTUTCv)
E4Lawrence (TC#500 3UTACOC)
E4Math. Sci. Ed. Board (TC#500 3MEAUPP)
E4MD Assm. Consort. (TC# 000 3MARASC)
E4MD Assm. Consort. (TC# 060 3PERAST)
E4Mead (TC#500 3IAEPPA)
E4Nat'l Coun. of Tchrs. of Math. (TC# 500 6MATASAv)
E4Nat'l Ctr. for Res. on Eval. (TC#150 6ASSWHCv)
E4NC Dept. of Pub. Instr. (TC# 500 3LINCUT)
E4Nicoll (TC#500.3MTDIAC2)
E4OR DOE (TC#500 3ORDIPS)
E4Psych. Corp. (TC#500 3INTASM)
E4Psych. Corp. (TC#510 3GOALS)
E4Qin (TC# 500 3MNMATG)
E4Reg. Ed. Lab. Net. Prog. (TC# 000 6TOOKIP2)
E4Riverside Pub. Co. (TC#500 3CALPRL)
E4Shoecraft (TC#500 3MOVITM)
E4Webb (TC#500 6COLGRV)

E5Burns (TC#500 5MATLIT)
E5Burton (TC#500 5ADDSEK)
E5CT DOE (TC#000 3CONCOC)
E5Ed. Testing Service (TC# 000 3MISALA)
E5Finston (TC#500 3STUASU)
E5Hibbard (TC#500 3SELUSF)
E5Horn (TC#000 3LANCOP)
E5Katims (TC# 500 3PACKET)
E5Kulm (TC# 500 6MATASW)
E5Math. Sci. Ed. Board (TC#500 3MEAUPP)
E5MD Assm. Consort. (TC# 000 3PERAST)
E5Nat'l Coun. of Tchrs. of Math. (TC# 500 6MATASAv)
E5Nat'l Ctr. for Res. on Eval. (TC#150 6ASSWHCv)
E5Pandey, Tej (TC#500 3SAMMAA)
E5Pfeiffer (TC#500 3NIMGAP)
E5Reg. Ed. Lab. Net. Prog. (TC# 000 6TOOKIP2)

E6Bagley (TC# 500 6ASSSTD)
E6Bellingham Pub. Sch., (TC# 000 3BELPUS)
E6Crowley (TC#500.3STUMAP)
E6Knight (TC#530 3HOWITS)
E6Koretz (TC# 000.6VERPOF)
E6Kulm (TC# 500 6MATASW)
E6Lambdin (TC#500 3PLAPOA)
E6Nat'l Coun. of Tchrs. of Math. (TC# 500 6MATASAv)
E6Nat'l Ctr. for Res. on Eval. (TC#150 6ASSWHCv)
E6OR New Stand. Proj. (TC# 000 3STUPOQ)
E6Pandey (TC#500.3SAMMAA)
E6Paulson (TC#500.6PORGUP)
E6Pritchard (TC#500 3STUPOT)
E6Reg. Ed. Lab. Net. Prog. (TC# 000 6TOOKIP2)
E6Serrano (TC# 000.3LOOPOA)
E6Thompson (TC#500 3PORMOD)
E6VA DOE (TC#500 3GRAFOB)
E6VA DOE (TC#500 3RESBOO)
E6VA DOE (TC#500 3TEAGUI)
E6VT DOE (TC#500 3GRAEIB)
E6Wilkins (TC# 530 3STUPOA)

E7Aurora Pub. Schools (TC#000 3SCIMAP)
E7Burns (TC#500 5MATLIT)
E7Burton (TC#500 5ADDSEK)
E7CT DOE (TC#000.3CONCOC)
E7Doig (TC# 500 3ACTASM)
E7Ed. Testing Service (TC# 000.3MISALA)
E7Finston (TC#500 3STUASU)
E7Horn (TC#000 3LANCOP)
E7Katims (TC# 500 3PACKET)
E7Kulm (TC# 500 6MATASW)
E7MD Assm. Consort. (TC# 000 3PERAST)
E7Nicoll (TC#500.3MTDIAC2)
E7Pfeiffer, Sherron (TC#500 3NIMGAP)
E7Reg. Ed. Lab. Net. Prog. (TC# 000 6TOOKIP2)
E7Webb (TC#500 6COLGRV)

E8Burton (TC#500 5ADDSEK)
E8Doig (TC# 500.3ACTASM)
E8Hall (TC#500.3ALBGRN)
E8Harvey (TC#500.6MATTEC)
E8Kaiims (TC# 500 3PACKET)
E8Kulm (TC# 500 6MATASW)
E8MD Assm. Consort. (TC# 000 3PERAST)
E8Nat'l Ctr. for Res. on Eval. (TC#150 6ASSWHCL)
E8Pfeiffer (TC#500 3MMGAP)
E8Reg. Ed. Lab. Net. Prog. (TC# 000 6TOOKIP2)
E8Secada (TC# 500 4INTCOR)
E8Semple (TC#600 3PERASS)

E9CT DOE (TC#000 3CONCOC)

E10Ed. Testing Service (TC#500 6NAEPMAR)

F1Alberta Ed. (TC#500 3DIAMAP)
F1Alberta Ed. (TC#500 3DIPEXP)
F1Aurora Pub. Schools (TC#000 3SCIMAP)
F1AZ Stud. Assm. Prog.(TC# 500 3ARISTM2)
F1Badger (TC#500 3ONTHOM)
F1Bagley (TC# 500 6ASSSTD)
F1Baxter (TC# 500 6MATPEA)
F1CA Assm. Prog. (TC#500 3SAMMAA2)
F1CA DOE (TC# 000 6STUSTS)
F1CA DOE (TC#500 3AQUESO)
F1Collis (TC#500 3COLROM)
F1CT DOE (TC#000 3CONCOC)
F1CTB McGraw-Hill (TC#500 3CTBMAT)
F1Curriculum Corp. (TC#500 3MATCUP)
F1Doig (TC# 500 3ACTASM)
F1Ed. Testing Service (TC#500 6NAEPMAR)
F1Ed. Testing Service (TC# 000 3MISALA)
F1Finston (TC#500 3STUASU)
F1Hartman (TC#500 3MATPOO)
F1Hibbard (TC#000 6TOGSTC)
F1Hibbard (TC#500 3SELUSP)
F1Knight (TC#530 3HOWITS)
F1Kulm (TC# 500 6MATASW)
F1Lane (TC#500.3QUACOA)
F1Larter (TC#100.6BENCHM)
F1Lawrence (TC#000.6INTUTC)
F1Lawrence (TC#500.3UTACOC)
F1Lehman (TC#500.3PERASM)
F1Madaus (TC# 000 6BRIEXA)
F1Math. Sci. Ed. Board (TC#500 3MEAUPP)
F1MD Assm. Consort. (TC# 000 3MARASC)
F1MD Assm. Consort. (TC# 000 3PERAST)
F1MD DOE (TC# 500 3MSPAPM)
F1Meltzer (TC#010 3SUROFP)
F1Models of Auth. Assm. (TC#500 3SUPTEM)
F1NC Dept. of Pub. Instr. (TC# 500 3LINCUI)
F1Newmann (TC# 050 3GUTAUT)
F1Nicoll (TC#500 3MTDIAC2)
F1OR DOE (TC#500 3ORDIPS)
F1OR New Stand. Proj. (TC# 000 3STUPOQ)
F1Paulson (TC#500 6PORGUP)
F1Perlman (TC# 000 3CPSPEA)
F1Psych. Corp. (TC#500 3INTASM)
F1Psych. Corp. (TC#510 3GOALS)
F1Qin (TC# 500 3MNMATG)
F1Reg. Ed. Lab. Net. Prog. (TC# 000 6TOOKIP2)
F1Semple (TC#600 3PERASS)
F1Shoecraft (TC#500 3MOVITM)
F1Thompson (TC#500 3PORMOD)
F1Webb (TC#500 6COLGRV)
F1Whetton (TC#070 3KEY193)

F2Alberta Ed. (TC#500 3DIAMAP)
F2Alberta Ed. (TC#500 3DIPEXP)
F2Aurora Pub. Schools (TC#000 3SCIMAP)
F2AZ Stud. Assm. Prog.(TC# 500 3ARISTM2)
F2Bagley (TC# 500 6ASSSTD)
F2CA Assm. Prog. (TC#500 3SAMMAA2)
F2CA DOE (TC# 000 6STUSTS)
F2CA DOE (TC#500 3AQUESO)
F2CT DOE (TC#000 3CONCOC)
F2CTB McGraw-Hill (TC#500 3CTBMAT)
F2Curriculum Corp. (TC#500 3MATCUP)
F2Doig (TC# 500 3ACTASM)
F2Ed. Testing Service (TC# 000 3MISALA)
F2Finston (TC#500 3STUASU)
F2Hartman (TC#500 3MATPOO)
F2Hibbard (TC#000 6TOGSTC)
F2Hibbard (TC#500 3SELUSP)
F2Kulm (TC# 500 6MATASW)
F2Lawrence (TC#000 6INTUTC)
F2Lawrence (TC#500 3UTACOC)
F2Madaus (TC# 000 6BRIEXA)
F2Math. Science Ed. Board (TC#500 3MEAUPP)
F2MD Assm. Consort. (TC# 000 3MARASC)
F2MD Assm. Consort. (TC# 000 3PERAST)
F2Models of Auth. Assm. (TC#500 3SUPTEM)
F2Newmann (TC# 050 3GUTAUT)
F2OR New Stand. Proj. (TC# 000 3STUPOQ)
F2Perlman (TC# 000.3CPSPEA)
F2Reg. Ed. Lab. Net. Prog. (TC# 000 6TOOKIP2)
F2Riverside Pub. Co. (TC#500 3CALPRL)

F3MD Assm. Consort. (TC# 000 3PERAST)
F3Perlman (TC# 000 3CPSPEA)
F3Reg. Ed. Lab. Net. Prog. (TC# 000 6TOOKIP2)

F4Alberta Ed. (TC#500 3DIAMAP)
F4Alper (TC# 500 3VARIMP)
F4Aurora Pub. Schools (TC#000 3SCIMAP)
F4AZ Stud. Assm. Prog.(TC# 500 3ARISTM2)

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F4Badger (TC#500 3ONTHOM)
F4CA Assm. Prog. (TC#500.3SAMMAA2)
F4CA DOE (TC# 000.6STUSTS)
F4Charles (TC#500 6HOWTOE)
F4Crowley (TC#500 3STUMAP)
F4CT DOE (TC#000 3CONCOC)
F4CTB McGraw-Hill (TC#500 3CTBMAT)
F4Curriculum Corp (TC#500 3MATCUP)
F4Doig (TC# 500 3ACTASM)
F4Ed. Testing Service (TC#500 6NAEPMAR)
F4Ft. Hays Ed. Dev. Center (TC# 500 3STAASM)
F4Greenwood (TC#500 6ONNATT)
F4Hall (TC#500 3ALBGRN)
F4Hartman (TC#500 3MATPOO)
F4Horn (TC#000 3LANCOP)
F4Hynes (TC#500 3K-5MAP)
F4Katims (TC# 500 3PACKET)
F4Kulm (TC# 500 6MATASW)
F4Lane (TC#500 3QUACOA)
F4Larter (TC#100 6BENCHM)
F4Lawrence (TC#000 6INTUTCV)
F4Lawrence (TC#500 3UTACOC)
F4Leach (TC#500 3ALTFOE)
F4Lehman (TC#500 3PERASM)
F4Math. Science Ed. Board (TC#500 3MEAUPP)
F4MD Assm. Consort. (TC# 000 3MARASC)
F4MD Assm. Consort. (TC# 000 3PERAST)
F4MD DOE (TC# 500 3MSPAPM)
F4NC Dept. of Pub. Instr. (TC# 500 3LINCUT)
F4Newmann (TC# 050 3GUIAUT)
F4Nicoll (TC#500 3MTDIAC2)
F4OR DOE (TC#500 3ORDIPS)
F4OR New Stand. Proj. (TC# 000 3STUPOQ)
F4Paulson (TC#500 6PORGUP)
F4Perlman (TC# 000 3CPSPEA)
F4Pfeiffer (TC#500 3NIMGAP)
F4Psych. Corp (TC# 500 3AMAP-M)
F4Psych. Corp (TC#500 3INTASM)
F4Psych. Corp (TC#510 3GOALS)
F4Reg. Ed. Lab. Net. Prog. (TC# 000 6TOOKIP2)
F4Riverside Pub. Co. (TC#500 3CALPRI)
F4Thompson (TC#500.3PORMOD)
F4VA DOE (TC#500.3GRAFOB)
F4VA DOE (TC#500.3TEAGUT)
F4VT DOE (TC#500 3GRAEIB)
F4Webb (TC#500 6ALTSTF)

F5Aurora Public Schools (TC#000 3SCIMAP)
F5CT DOE (TC#000 3CONCOC)
F5Finston (TC#500 3STUASU)
F5Katims (TC# 500 3PACKET)
F5Kulm (TC# 500 6MATASW)
F5Leach (TC#500 3ALTFOE)
F5Lehman (TC#500 3PERASM)
F5Perlman (TC# 000.3CPSPEA)
F5Reg. Ed. Lab. Net. Prog. (TC# 000 6TOOKIP2)

F6AZ Stud. Assm. Prog. (TC# 500 3ARISTM2)
F6Bagley (TC# 500 6ASSSTD)
F6CA Assm. Prog. (TC#500 3SAMMAA2)
F6CA DOE (TC#500 3AQUESO)
F6Crowley (TC#500 3STUMAP)
F6CT DOE (TC#000 3CONCOC)
F6Ed. Testing Service (TC# 000 3MISALA)
F6Finston (TC#500 3STUASU)
F6Ft. Hays Ed. Dev. Center (TC# 500 3STAASM)
F6Hall (TC#500 3ALBGRN)
F6Hartman (TC#500 3MATPOO)
F6Hibbard (TC#000 6TOGSTC)
F6Hibbard (TC#500.3SELUSP)
F6Horn (TC#000 3LANCOP)
F6Kulm (TC# 500 6MATASW)
F6Lambdin (TC#500.3PLAPOA)
F6Lane (TC#500 3QUACOA)
F6Lehman (TC#500 3PERASM)
F6Math. Sci. Ed. Board (TC#500 3MEAUPP)
F6MD Assm. Consort. (TC# 000 3PERAST)
F6MD DOE (TC# 500 3MSPAPM)
F6Mead (TC#500 3IAEPPA)
F6Newmann (TC# 050 3GUIAUT)
F6Nicoll (TC#500 3MTDIAC2)
F6OR DOE (TC#500 3ORDIPS)
F6OR New Stand. Proj. (TC# 000 3STUPOQ)
F6Perlman (TC# 000 3CPSPEA)
F6Psych. Corp. (TC# 500.3AMAP-M)
F6Psych. Corp. (TC#500 3INTASM)
F6Psych. Corp. (TC#510.3GOALS)
F6Reg. Ed. Lab. Net. Prog. (TC# 000 6TOOKIP2)
F6Riverside Pub. Co. (TC#500 3CALPRI)
F6Thompson (TC#500.3PORMOD)
F6VA DOE (TC#500 3GRAFOB)
F6VA DOE (TC#500 3TEAGUT)
F6VT DOE (TC#500 3GRAEIB)

F7Bagley (TC# 500 6ASSSTD)
F7Lambdin (TC#500 3PLAPOA)
F7Reg. Ed. Lab. Net. Prog. (TC# 000 6TOOKIP2)

F8CA Assm. Prog. (TC#500.3SAMMAA2)
F8CT DOE (TC#000 3CONCOC)
F8Curriculum Corp. (TC#500 3MATCUP)
F8Ft. Hays Ed. Dev. Center (TC# 500 3STAASM)
F8Hartman (TC#500 3MATPOO)
F8Hynes (TC#500 3K-5MAP)
F8Katims (TC# 500 3PACKET)
F8Kulm (TC# 500 6MATASW)
F8Lane (TC#500 3QUACOA)
F8Larter (TC#100 6BENCHM)

F8Lehman (TC#500 3PERASM)
F8MD Assm. Consort. (TC# 000 3PERAST)
F8Mead (TC#500 3IAEPPA)
F8Meltzer (TC#010.3SUROFP)
F8OR New Stand. Proj. (TC# 000 3STUPOQ)
F8Perlman (TC# 000 3CPSPEA)
F8Psych Corp (TC#500 3INTASM)
F8Reg Ed Lab Net Prog (TC# 000 6TOOKIP2)
F8Semple (TC#600 3PERASS)

F9Ft. Hays Ed Dev Center (TC# 500 3STAASM)
F9Reg Ed Lab Net Prog. (TC# 000 6TOOKIP2)

F10Center for Talent Dev (TC#220 3QUEELM)
F10Crowley (TC#500 3STUMAP)
F10Curriculum Corp (TC#500 3MATCUP)
F10Kloosterman (TC#500 3MEABEM)
F10Knight (TC#530 3HOWIUS)
F10Larter (TC#100 6BENCHM)
F10Tittle (TC# 500 3MATASQ)

G1Alberta Ed. (TC#500 3DIAMAP)
G1Alberta Ed. (TC#500 3DIPEXP)
G1Appalachia Ed. Lab (TC# 600 3ALTASM)
G1Aurora Pub Schools (TC#000 3SCIMAP)
G1Bagley (TC# 500 6ASSSTD)
G1Baxter (TC# 500 6MATPEA)
G1CA DOE (TC#500 3AQUESO)
G1Clark (TC#500 3AIMHIM)
G1Collis (TC#500 3COLROM)
G1CTB McGraw-Hill (TC#500 3CTBMAT)
G1Doig (TC# 500 3ACTASM)
G1Ed. Testing Service (TC#500 6NAEPMAR)
G1Ed. Testing Service (TC# 000 3MISALA)
G1Hibbard (TC#000 6TOGSTC)
G1Hibbard (TC#500 3SELUSP)
G1Kulm (TC# 500 6MATASW)
G1KY DOE (TC# 060 3KIRIS94)
G1Lane (TC#500 3QUACOA)
G1Lawrence (TC#000 6INTUTCv)
G1Lawrence (TC#500 3UTACOC)
G1Madaus (TC# 000 6BRIEXA)
G1Math. Sci. Ed. Board (TC#500 3MEAUPP)
G1MD Assm. Consort. (TC# 000 3MARASC)
G1MD Assm. Consort. (TC# 000 3PERAST)
G1MD DOE (TC# 500 3MSPAPM)
G1MD DOE (TC#000 3COMST)
G1Mead (TC#500 3IAEPPA)
G1Meltzer (TC#010 3SUROFP)
G1Models of Auth. Assm. (TC#500 3SUPTEM)
G1Pfeiffer (TC#500 3NIMOAP)
G1Psych. Corp (TC#510 3GOALS)
G1Reg Ed Lab Net Prog (TC# 000 6TOOKIP2)
G1Riverside Pub Co (TC#500 3CALPRL)
G1Semple (TC#600 3PERASS)
G1Webb (TC#500 6COLGRV)
G1Whetton (TC#070 3KEY193)

G2Ed. Testing Service (TC# 000 3MISALA)
G2Kulm (TC# 500 6MATASW)
G2Perlman (TC# 000 3CPSPEA)
G2Psych. Corp.(TC# 500 3AMAP-M)
G2Reg. Ed. Lab. Net. Prog. (TC# 000 6TOOKIP2)

G3AZ Stud. Assm. Prog.(TC# 500 3ARISTM2)
G3Bellingham Pub. Sch., (TC# 000 3BELPUS)
G3CA Assm. Prog. (TC#500 3SAMMAA2)
G3Charles (TC#500 6HOWTOE)
G3CTB McGraw-Hill (TC# 060 3CAT-5a)
G3Ed. Testing Service (TC# 000 3MISALA)
G3Hynes (TC#500 3K-5MAP)
G3Kulm (TC# 500 6MATASW)
G3MD Assm. Consort. (TC# 000 3MARASC)
G3MD DOE (TC#000 3COMST)
G3Meltzer (TC#010 3SUROFP)
G3NC Dept. of Pub. Instr. (TC# 500 3LINCUT)
G3Pandey (TC#500 3SAMMAA)
G3Paulson (TC#500 6PORGUP)
G3Perlman (TC# 000 3CPSPEA)
G3Psych. Corp.(TC# 500 3AMAP-M)
G3Psych. Corp. (TC#500 3INTASM)
G3Reg. Ed. Lab. Net. Prog. (TC# 000 6TOOKIP2)
G3Riverside Pub Co (TC#500 3CALPRL)
G3Thompson (TC#500 3PORMOD)

G4Charles (TC#500 6HOWTOE)
G4Clarridge (TC# 150 6IMPNEE)
G4Curriculum Corp. (TC#500 3MATCUP)
G4Ed. Testing Service (TC# 000 3MISALA)
G4Ft. Hays Ed. Dev. Center (TC# 500 3STAASM)
G4Hall (TC#500 3ALBGRN)
G4Hartman (TC#500 3MATPOO)
G4Hibbard (TC#000 6TOGSTC)
G4Hibbard (TC#500 3SELUSP)
G4Horn (TC#000 3LANCOP)
G4Kulm (TC# 500 6MATASW)
G4Lambdin (TC#500 3PLAPOA)
G4Leach (TC#500 3ALTFOE)
G4Lehman (TC#500 3PERASM)
G4Newmann (TC# 050 3OUTAUT)
G4OR DOE (TC#500 3ORDIPS)
G4OR New Stand. Proj. (TC# 000 3STUPOQ)
G4Perlman (TC# 000 3CPSPEA)
G4Psych. Corp. (TC#500 3INTASM)
G4Reg. Ed. Lab. Net. Prog. (TC# 000 6TOOKIP2)
G4VA DOE (TC#500 3GRAFOB)
G4VA DOE (TC#500 3TEAGUT)
G4VT DOE (TC#500 3GRAEIB)